



# STIC Search Report

## EIC 3700

STIC Database Tracking Number: 139908

**TO: Andrea Ragonese**  
**Location: RND 7c59**  
**Art Unit: 3743**  
**Friday, December 17, 2004**

**Case Serial Number: 10/650114**

**From: Emory Damron**  
**Location: EIC 3700**  
**Randolph 8-A-34**  
**Phone: 571-272-3520**

**Emory.Damron@uspto.gov**

### Search Notes

Dear Andrea,

Please find below an inventor search in the bibliographic and full-text foreign patent files, as well as keyword searches in the patent and non-patent literature files, both bibliographic and full text.

References of potential pertinence have been tagged, but please review all the packets in case you like something I didn't.

Of those references which have been tagged, please note any manual highlighting which I've done within the document.

In addition to searching on Dialog, I also searched EPO/JPO/Derwent, Scirus/ScienceDirect, Google Scholar and STN/CAS.

There are a few decent references contained herein, but I'll let you determine how useful they may be to you. My favorite is to Larsson et. al. (EP 653183, or the US equivalent, 5540233).

Please contact me if I can refocus or expand any aspect of this case, and please take a moment to provide any feedback (on the form provided) so EIC 3700 may better serve your needs. Good Luck!

Sincerely,

Emory Damron

Technical Information Specialist

EIC 3700, US Patent & Trademark Office

Phone: (571) 272-3520/ Fax: (571) 273-0047

Emory.damron@uspto.gov



## Solomon, Terrance

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From: Unknown@Unknown.com  
Sent: Wednesday, December 08, 2004 7:41 PM  
To: STIC-EIC3700  
Subject: Generic form response

ResponseHeader=Commercial Database Search Request

AccessDB#= 139908

LogNumber= \_\_\_\_\_

Searcher= \_\_\_\_\_

SearcherPhone= \_\_\_\_\_

SearcherBranch= \_\_\_\_\_

MyDate=Wed Dec 8 19:40:39 EST 2004

submitto=STIC-EIC3700@uspto.gov

Name=Andrea Ragonese

Empno=77465

Phone=571-272-4804

Artunit=3743

Office=RND D07C59

Serialnum=10650114

PatClass=128/204.18

Earliest=08/26/2003

Format1=paper

Searchtopic=This is a method for use with a RESPIRATORY DEVICE for providing VENTILATION OF THE LUNGS by measuring the GAS EXCHANGE EFFICACY / EFFICIENCY using the INERT GAS ELIMINATION TECHNIQUE. The apparatus that uses this method measures the INERT GAS / NITROGEN / N2 / SF6 / SULFUR HEXAFLUORIDE / HELIUM / HE / FLUOROPROPANE / ANESTHETIC GAS / ANESTHESIA CONCENTRATION / CONTENT/ AMOUNT / PERCENTAGE of the END TIDAL BREATH of a patient.

Comments=

send=SEND

DEC -9 2004

X -COPY

Set	Items	Description
S1	122920	RESPIRAT? OR INSUFFLAT? OR VENTILAT? OR BREATHE? OR BREATH- ING OR INHALAT? OR PCV OR VCV OR PEEP OR POSITIVE()END()EXPIR- ?()PRESSUR?
S2	453	(LUNG? OR PULMON?) (5N) (CAPACIT? OR VOLUM?)
S3	1431	(GAS OR GASES OR GASSES) (3N) (FLOW? OR EXCHANG? OR BACK(2W)- FORTH) (3N) (EFFICIEN? OR EFFICAC? OR EFFECTIVENESS? OR HOMOGEN? OR INHOMOGEN?)
S4	92887	BREATH?() (GAS OR GASES OR GASSES) OR ANESTH? OR ANAESTH? OR NITROUS()OXID? OR LAUGHING()GAS OR N2O OR N()SUB()2()O OR CA- RBON()DIOXID? OR CO2 OR CO()SUB()2 OR CARBONIC()ANHYDRID?
S5	0	RN=(124-38-9 OR 10024-97-2)
S6	1418973	CONCENTRATION? OR STRENGTH? OR PERCENT? OR POTENC? OR DILU- T?(2N) (RATIO? OR FACTOR? OR MIXTUR? OR ADMIX?) OR AMOUNT? OR - CONTENT
S7	1498047	MEASUR? OR MENSUR? OR DETERMIN? OR CALCULAT? OR QUANTIF? OR ESTIMAT? OR GAUG? OR EVALUAT? OR ASCERTAIN? OR COMPUTING?
S8	26697	BREATH OR BREATHS OR INSPIRATION? OR INHALATION? OR ENDBRE- ATH? OR TIDALBREATH?
S9	2193945	ELIMINAT? OR RID OR RIDS OR RIDDING OR REMOV? OR EXPURG? OR PURG? OR SUBTRACT? OR ADJUST?
S10	68308	INERT(2N) (GAS OR GASES OR GASSES) OR ANESTH? OR ANAESTH? OR FLUOROPROPAN? OR FLUORO()PROPAN? OR HFC()281 OR HFC281 OR HY- DROFLUOROCARBON()281
S11	234362	NITROGEN OR N()SUB()2 OR N2 OR HELIUM OR HE OR (SULFUR OR - SULPHUR) () (FLUORID? OR HEXAFLUORID?) OR ELEGAS OR SF6 OR SF()- SUB()6
S12	0	RN=(7440-59-7 OR 2551-62-4 OR 7727-37-9)
S13	2397666	METHOD OR METHODS
S14	2133196	SYSTEM OR SYSTEMS
S15	161444	PROCEDURE?
S16	1623878	PROCESS OR PROCESSES
S17	123458	TECHNIQUE?
S18	281721	IC=(A61B? OR A61M? OR G01F?)
S19	12285	S1 AND S18
S20	122920	S1 OR S19
S21	280	S20 AND S2
S22	0	S21 AND S3
S23	66	S21 AND (S7 OR S9) AND (S4:S5 OR S10:S12)
S24	65	S23 AND (S6 OR S8 OR S13:S17)
S25	82	S21 AND S7(5N)S2
S26	58	S21 AND (S7 OR S9) (5N) (S6 OR S8 OR S4:S5 OR S
S27	193	S21 AND S18
S28	64	S27 AND S13:S17(5N) (S7 OR S9)
S29	149	S23:S26 OR S28
S30	149	IDPAT (sorted in duplicate/non-duplicate order)

? show files

File 350:Derwent WPIX 1963-2004/UD,UM &UP=200481

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*Pat Lit*

*BIBLIOG.  
FILES*

*SELECTED*

*EDITED*

*HITS*

~~XXXXXXXXXX~~

30/3,K/1

DIALOG(R)File 350:Derwent WPIX

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009271149 \*\*Image available\*\*

WPI Acc No: 1992-398561/199248

XRAM Acc No: C92-176784

XRPX Acc No: N92-304059

**Associated respiratory gas exchange method - comprises introducing into pulmonary air passages of mammalian host, vol. of perfluorocarbon liq**

Patent Assignee: UNIV PITTSBURGH (UYPI-N); ALLIANCE PHARMACEUTICAL CORP (ALLI-N)

Inventor: FAITHFULL N S; WEERS J G; FUHRMAN B P

Number of Countries: 018 Number of Patents: 009

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 9219300	A1	19921112	WO 91US7142	A	19910927	199248 B
AU 9189175	A	19921221	AU 9189175	A	19910927	199311
			WO 91US7142	A	19910927	
EP 582570	A1	19940216	EP 91920110	A	19910927	199407
			WO 91US7142	A	19910927	
JP 6507320	W	19940825	JP 91518454	A	19910927	199438
			WO 91US7142	A	19910927	
EP 582570	A4	19940713	EP 91920110	A	19910000	199532
US 5437272	A	19950801	US 91694290	A	19910501	199536
AU 9660540	A	19961031	AU 9189175	A	19910927	199651
			AU 9219271	A	19920501	
			AU 9660540	A	19960716	
JP 2606994	B2	19970507	JP 91518454	A	19910927	199723
			WO 91US7142	A	19910927	
AU 704024	B	19990415	AU 9189175	A	19910927	199926
			AU 9219271	A	19920501	
			AU 9660540	A	19960716	

*related document beneath*

Priority Applications (No Type Date): US 91694290 A 19910501; US 91695547 A 19910503

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
WO 9219300	A1	48	A61M-016/00		
					Designated States (National): AU CA JP US
					Designated States (Regional): AT BE CH DE DK ES FR GB GR IT LU NL SE
AU 9189175	A		A61M-016/00		Based on patent WO 9219300
EP 582570	A1 E		A61M-016/00		Based on patent WO 9219300
					Designated States (Regional): AT BE CH DE DK ES FR GB GR IT LI LU NL SE
JP 6507320	W	16	A61M-016/14		Based on patent WO 9219300
US 5437272	A	24	A61M-015/00		
AU 9660540	A		A61M-016/14		Div ex application AU 9189175 Div ex application AU 9219271 patent WO 9219300
JP 2606994	B2	21	A61K-031/02		Previous Publ. patent JP 6507320 Based on patent WO 9219300
AU 704024	B		A61M-016/14		Div ex application AU 9189175 Div ex application AU 9219271 Previous Publ. patent AU 9660540
EP 582570	A4		A61M-016/00		

**Associated respiratory gas exchange method -**

...Abstract (Basic): **Respiratory** gas exchange is maintained by introducing a vol. of perfluorocarbon liq. into the pulmonary air passages of a mammalian host, the vol. being equal to, or less than,

the **pulmonary** functional residual **capacity** of the host...

... **Respiratory** gas exchange in the liq. laden air passages is maintained by a gas **ventilator** for a treatment period. The perfluorocarbon liq. is subsequently **removed** from the air passages...

...USE/ADVANTAGE - The use of perfluorocarbon liq. ventillation provides treatment for **respiratory** distress syndromes involving surfactant deficiency or dysfunction in human or other mammalian patients. The potential...

...Additionally, the pulmonary time constant is far lower during the present treatment than during liq. **breathing**, making it possible to **ventilate** the patient more rapidly and to achieve far greater minute **ventilation**.

...Abstract (Equivalent): Maintaining **respiratory** gas exchange comprises introducing into the pulmonary air passages of a mammalian host a vol. of perfluorocarbon liq. of 50-100% of the **pulmonary** functional residual **capacity** of the host; and physically administering a vol. of **breathing gas** with the introduced vol. of liq. in the air passages whereby the **breathing gas** forms bubbles inside the liq-contg. air passages so that oxygenation of the perfluorocarbon liq. takes place in vivo and resulting when the host takes multiple **breaths** of a **breathing gas**.

...Title Terms: **RESPIRATION** ;

...International Patent Class (Main): **A61M-015/00** ...

... **A61M-016/00** ...

... **A61M-016/14**



US005437272A

**United States Patent** [19]

Fuhrman

[11] Patent Number: 5,437,272

[45] Date of Patent: Aug. 1, 1995

- [54] **PERFLUOROCARBON ASSOCIATED GAS EXCHANGE**
- [75] Inventor: Bradley P. Fuhrman, Pittsburgh, Pa.
- [73] Assignee: Alliance Pharmaceutical Corp., San Diego, Calif.
- [21] Appl. No.: 694,290
- [22] Filed: May 1, 1991
- [51] Int. Cl.<sup>6</sup> ..... A61M 15/00
- [52] U.S. Cl. .... 128/203.12; 128/204.18; 128/913
- [58] Field of Search ..... 128/204.18, 913, 203.12
- [56] **References Cited**

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| 5,024,995 | 6/1991 | Robertson et al. | 514/21     |
| 5,029,580 | 7/1991 | Radford et al.   | 128/207.14 |

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|------------|--------|----------|
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| 1143420    | 3/1985 | U.S.S.R. |
| WO91/03267 | 3/1991 | WIPO     |

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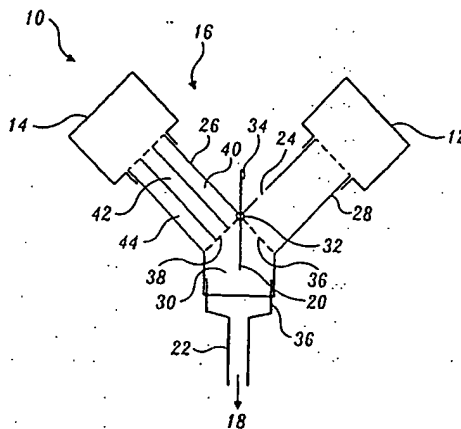
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(List continued on next page.)

Primary Examiner—Edgar S. Burr  
 Assistant Examiner—Aaron J. Lewis  
 Attorney, Agent, or Firm—Knobbe, Martens, Olson & Bear

**[57] ABSTRACT**

Method and means for maintaining respiratory gas exchange, by introducing into the pulmonary air passages of a mammalian host a volume of perfluorocarbon liquid substantially equivalent to the pulmonary functional residual capacity of the host, maintaining respiratory gas exchange in the perfluorocarbon liquid-laden pulmonary air passages by continuous positive pressure breathing with a conventional respirator, for up to an hour or more, and thereafter evaporating the perfluorocarbon liquid from the pulmonary air passages. Useful for treating pulmonary surfactant deficiency or dysfunction.

**18 Claims, 7 Drawing Sheets**

30/3,K/4

DIALOG(R) File 350:Derwent WPIX

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016655116 \*\*Image available\*\*

WPI Acc No: 2004-813836/200480

XRAM Acc No: C04-283155

XRPX Acc No: N04-642233

Ventilator system for nuclear magnetic resonance and/or magnetic resonance imaging procedures, has mass flow controller, gas delivery valve, first and second gas sources, first and second pressure sensors, and controller

Patent Assignee: BOLAM K (BOLA-I); BORGEN J (BORG-I); MEDI PHYSICS INC (MEDI-N)

Inventor: BOLAM K; BORGEN J

Number of Countries: 108 Number of Patents: 002

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 200496333	A1	20041111	WO 2004US12237	A	20040421	200480 B
US 20040230113	A1	20041118	US 2003464610	P	20030422	200480
			US 2004828824	A	20040421	

Priority Applications (No Type Date): US 2003464610 P 20030422; US 2004828824 A 20040421

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

WO 200496333 A1 E 75 A61M-016/12

Designated States (National): AE AG AL AM AT AU AZ BA BB BG BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NA NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SY TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW

Designated States (Regional): AT BE BG BW CH CY CZ DE DK EA EE ES FI FR GB GH GM GR HU IE IT KE LS LU MC MW MZ NL OA PL PT RO SD SE SI SK SL SZ TR TZ UG ZM ZW

US 20040230113 A1 F25B-021/00 Provisional application US 2003464610

Ventilator system for nuclear magnetic resonance and/or magnetic resonance imaging procedures, has mass flow controller, gas delivery valve, first and second gas sources, first and second...

Abstract (Basic):

... Ventilator system comprises mass flow controller; a gas delivery valve disposed downstream of and in communication with

... Ventilator system comprises a ventilation flow path for ventilating a subject; a mass flow controller; a gas delivery valve disposed downstream of and in...

...pressure sensors and the mass flow controller. The controller is configured to monitor the pressures measured by the pressure sensors and the flow rate of the mass flow controller, and to automatically determine a delivered tidal volume using a reading of the flow rate of the mass flow...

...CLAIM is also included for a computer program product for delivering hyperpolarized gas using a ventilator with an associated gas delivery valve and a tracheal tube, comprising a computer program code that monitors a first pressure in the ventilator system upstream of the gas delivery valve; a computer program code that monitors a second pressure in the ventilator system downstream of the gas delivery valve; a computer program code that obtains a reading of...

22 APRIL  
2003

...when the first pressure stabilizes at a constant pressure; and a computer program code that **calculates** a tidal volume using the reading of the mass flow controller when the first pressure...

...The inventive **system** is used for delivering a hyperpolarized gas to a subject, by providing the **ventilator system** with the mass flow controller, a tracheal tube and the gas delivery valve configured to...

...at least one non-polarized gas to the subject; monitoring a first pressure in the **ventilator system** upstream of the gas delivery valve; monitoring a second pressure in the **ventilator system** downstream of the gas delivery valve; obtaining a reading of the mass flow controller when the first pressure is constant; and automatically **determining** the tidal **inspiration** volume of hyperpolarized gas delivered to the subject in situ using the obtained mass flow...

...lagomorphs). It can also be used for nuclear magnetic resonance and/or magnetic resonance imaging **procedures**.

...The inventive **system** can more accurately **determine** the **amount** of gas and/or number of moles of gas delivered to an animal's lungs...

...1) a known or **calculated inspiration** or tidal volume of gas...

...3) in situ real-time or dynamic **adjustment** of flow rate based on pressure and volume parameters; and...

...4) controlled **ventilation** to provide blends or selectable **respiratory** gases, including at least one hyperpolarized gas...

...The figure is a block diagram of operations for **respiratory** and hyperpolarized gas delivery  
Technology Focus:

... Preferred Component: The controller is configured to automatically **adjust** the flow rate of the mass flow controller so that the pressure **measured** by the first pressure sensor is constant during delivery of hyperpolarized gas. The first gas...

...a polarized gas source. The second gas source is a non-polarized gas source. The **ventilator system** further comprises a tracheal tube in fluid communication with the gas delivery valve; a temperature...

...tracheal tube end cap for closing off the tracheal tube; a computer program code for **calculating** a fixed volume (V1); a physiological monitor for monitoring heart rate; and an electrocardiogram (ECG) device. The gas delivery valve is configured with a vent port that allows expired **breath** to vent during expiration. It is configured to operate at a selectable **breath** per minute rate and inhale/exhale ratio with **breath** -hold duration and to selectively deliver the polarized gas alone or with the non-polarized gas. The **ventilator system** is to be run in a user selectable set tidal volume mode or a set peak **inspiration** pressure mode. It is configured for small animals. It is configured to deliver a millimole **amount** of polarized  $^{129}\text{Xe}$  (xenon) gas and/or polarized  $^3\text{He}$  (**helium**). It is configured to operate with the selectable **breath** per minute rates of 5-180. It is configured to operate with selectable **inspiration** /expiration ratios of 5:1-1:5. It is configured to operate with a controllable peak **inspiration** pressure of 0-40 inches of water (H2O). It is configured to provide a tidal...



...minute. It is configured to operate with magnetic resonance imaging/nuclear magnetic resonance (MRI/NMR) **systems** having up to 5T magnetic fields or having less than 100 Gauss magnetic fields. The...

...variable mass flow rate. The controller is configured to dynamically monitor the first pressure and **adjust** the flow rate of the mass flow controller responsive to deliver a user-selected predetermined fixed tidal volume. It is configured to **calculate** an **adjusted** delivered tidal volume in situ based on the difference between the total tidal volume and a fixed geometric volume of the **ventilator** flow path that includes a portion of the **ventilator** flow path and the tracheal tube. It is configured to **determine** the delivered tidal volume using the mathematical relationship (1): flow rate/frequency=volume exhausted per ...

...flow controller taken when the first pressure is stable or constant and frequency is the **breath** per minute rate. It is configured to generate an **estimated** incremental decrease or increase of flow rate to provide a constant pressure at the first sensor based on the selected **breath** per minute rate and an **estimated volume** of the animal's **lungs**. It is operably associated with a computer program code of a library of a priori values of predicted animal volumetric characteristics and/or animal volumetric changes at different peak **inspiration** pressures. The temperature monitor is in communication with a thermal source that is configured to...

...controlled pressure of a non-polarized gas directed into the vessel. The computer program code **calculates** and applies a calibration factor to define the pressure used to compress the bag to...

...of polarized gas. The gas delivery valve is configured to provide gas flow paths for **ventilation breath** inhale inputs and/or receive exhale outputs of at least: a hyperpolarized Gas A inhale...

...A inhale and hold; and a non-polarized gas input. It is configured to provide **ventilation breath** inhale inputs and/or receive exhale outputs of at least: hyperpolarized Gas A inhale; non...

...with a material that inhibits depolarization of the hyperpolarized gas and is non-magnetic. The **ventilator system** has an associated fluid capacitance disposed intermediate the mass flow controller and the gas delivery...

...where the fluidic capacitance has a volume that is at least 10 times greater than the **volume** of the **lungs** of the subject; fixed **volume** reservoir(s) that is configured to selectively engage the manifold to **adjust** the fluidic capacitance responsive to pressure **measurements** obtained by the first and second pressure sensors; a syringe with a quantity of fluid, and being in communication with the manifold line and configured to selectively add or **remove** fluid from the manifold; and a second mass flow controller, where the first and second mass flow controllers are used to automatically provide desired blends of selected **ventilation** gases to the subject. The selected **breath** per minute cycle is 30 ...signal acquisition. The computer program product further comprises a computer program code that automatically dynamically **adjusts** the flow rate of the mass flow controller to maintain the constant first pressure during **ventilation** delivery of the hyperpolarized gas to the subject; a computer program code for accepting user...

...modes: a tidal volume operational mode with the desired tidal volume selected; and a peak **inspiration** pressure operational mode with the desired peak **inspiration** pressure selected; a computer program code that selectively configures the gas delivery valve for inhale, exhale, or **breath** -hold operation; a computer program code that selectively operates the gas delivery valve to output...

...polarized gas; a computer program code that controllably actuates the gas delivery valve to select **ventilation** operation between at least: the hyperpolarized gas inhale, the non-polarized gas inhale, a combination...

...operates the first and second mass flow controllers to automatically provide desired blends of selected **ventilation** gases to the subject. The hyperpolarized gas is a hyperpolarized noble gas. The non-polarized

...  
Title Terms: **VENTILATION** ;

International Patent Class (Main): **A61M-016/12** ...

International Patent Class (Additional): **A61B-005/05** ...

... **A61B-005/055**

30/3,K/6

DIALOG(R)File 350:Derwent WPIX

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016375270 \*\*Image available\*\*

WPI Acc No: 2004-533177/200451

XRFX Acc No: N04-422307

**Infant's forced expiratory maneuver performing method for testing pulmonary function, involves immediately deflating infant's lungs to produce maximum forced expiration**

Patent Assignee: SENSORMEDICS CORP (SENS-N)

Inventor: STENZLER A

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
US 20040129269	A1	20040708	US 2003338188	A	20030107	200451	B

Priority Applications (No Type Date): US 2003338188 A 20030107

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
US 20040129269	A1	10	A61M-016/00	

**Infant's forced expiratory maneuver performing method for testing pulmonary function, involves immediately deflating infant's lungs to produce maximum forced expiration**

Abstract (Basic):

... The method involves monitoring an end-tidal CO2 concentration of an infant's respiration during each respiratory cycle. Infant's lungs are inflated to total lung volume after a determination that the end-tidal CO2 concentration decreases from the baseline concentration by the pre-defined amount. The infant's lungs are immediately deflated to produce a maximum forced expiration.

... Lungs of an infant are inflated with air synchronously with natural tidal inspiration to a lung volume that is greater than that reached at an end tidal inspiration for consecutive respiratory cycles. The end-tidal CO2 concentration whether decreases or not from a baseline concentration by a predefined amount is determined. An INDEPENDENT CLAIM is also included for an apparatus of performing a maximum forced expiration...

...The method limits the risk in over reduction in carbon dioxide and also allows for the determination of the optimal time to perform the compression without the need to observe the respiratory effort of the infant for an extended period of time...

...Title Terms: METHOD ;

International Patent Class (Main): A61M-016/00

7 JAN  
2003

30/3,K/9

DIALOG(R)File 350:Derwent WPIX

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016329134

WPI Acc No: 2004-487031/200446

XRAM Acc No: C04-181347

XRPX Acc No: N04-384207

Method of providing breathing gases to the patient breathing in respiratory cycles involves passing expiratory breathing gases of patient along flow path and taking up given component from expiratory breathing gases passing in flow path

Patent Assignee: HEINONEN E (HEIN-I)

Inventor: HEINONEN E

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20040118402	A1	20040624	US 2002325534	A	20021219	200446 B

Priority Applications (No Type Date): US 2002325534 A 20021219

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
US 20040118402	A1	11	A61M-016/00	

Method of providing breathing gases to the patient breathing in respiratory cycles involves passing expiratory breathing gases of patient along flow path and taking up given component from expiratory breathing gases passing in flow path

Abstract (Basic):

... Altering the amount of a given component in breathing gases provided to the patient breathing in respiratory cycles involves passing expiratory breathing gases of the patient along a flow path; taking up a quantity of the given component from expiratory breathing gases passing in the flow path; and releasing the component taken up into the inspiratory breathing gases to raise the concentration of the component in the inspiratory breathing gases for the patient.

... Altering the amount of a given component in breathing gases provided to the patient breathing in respiratory cycles involves passing expiratory breathing gases of the patient along a flow path; taking up a quantity of the given component from expiratory breathing gases passing in the flow path; and releasing the component taken up into the inspiratory breathing gases to raise the concentration of the component in the inspiratory breathing gases for the patient. Each of the respiratory cycles, has an inspiration phase in which inspiratory breathing gases are provided to the patient and an expiration phase in which the patient exhales expiratory breathing gases. The given component is present in the expiratory breathing gases of the patient...

...An INDEPENDENT CLAIM is included for an apparatus for altering the amount of a given amount in breathing gases provided to the patient, includes a conduit, a gas component exchanger and a selector. The conduit has a flow path for providing inspiratory breathing gases to the patient during the inspiratory phases of the respiratory cycles and receiving expiratory breathing gases from the patient during the expiratory phases of the respiratory cycles. The gas component exchanger...

...releasing the given component in gas passing through the exchanger. The

*INVENTOR*

19 DEC  
2002

compare  
CLAIM 1C  
in  
10/650114

selector device selectively passes **inspiration** and expiration **breathing gases** in the conduit through the exchanger. The exchanger takes up the given component from the expiratory **breathing gases** in an expiratory phase and then releases the component into the inspiratory **breathing gases** in an inspiratory phase to raise the concentration of the component in the **inspiration breathing gases** provided to the patient...

...The **method** is useful for altering the **amount** of a given component in **breathing gases** provided to the patient and for non-invasively **determining** a circulatory **system** condition e.g. a functional cardiac output of the patient...

...The **method** carry out the alteration without affecting the exchange of other respiratory gases such as oxygen...

...disturbance to the patient care environment and minimizes the overall increase in the breathing circuit- **lung** dead-space **volume** .

#### Technology Focus:

... in the flow path of the conduit means and a device for selectively passing the **breathing gases** through the exchanger or diverting the **breathing gases** from the exchanger. The device for passing or diverting the **breathing gases** includes an alternative flow path for the **breathing gases** containing a gas treatment device. The gas treatment device comprises a heat and moisture exchanger...

...substantially the same. The apparatus further includes a valve for selectively passing or diverting the **breathing gases** . The exchanger includes activated charcoal or zeolite for taking up and releasing the given component in **breathing gases** passing through the exchanger. The apparatus further includes a ventilator coupled to the conduit for ...

...gases to the patient and receiving expiratory gases from the patient; a flow meter for **measuring** the flow of **breathing gases** ; and a **breathing gas** component **measuring** component between the exchanger and the patient...

...Preferred **Method** : The **method** further involves: selectively inserting the exchanger into the flow path for the **breathing gases** and the exchanger takes up a quantity of the given component from expiratory **breathing gases** in the flow path and releases the given component in inspiratory **breathing gases** in the flow path. The **method** also involves selectively passing **breathing gases** or bypassing the **breathing gases** around the exchanger. The exchanger takes up a quantity of the given component from expiratory **breathing gases** passing through the exchanger and releasing the given component in inspiratory **breathing gases** passing through the exchanger...

...Preferred Gas: The given **breathing gas** component is **CO2** .

Title Terms: **METHOD** ;

International Patent Class (Main): **A61M-016/00**

30/3,K/15

DIALOG(R)File 350:Derwent WPIX

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015901768

WPI Acc No: 2004-059608/200406

Related WPI Acc No: 2003-102284

XRAM Acc No: C04-024560

XPX Acc No: N04-048196

**Assessment of concentration of compound, e.g. inhalation compound in brain of subject involves administering gas containing compound into subject to fill pulmonary functional residual capacity**

Patent Assignee: LIN C (LINC-I)

Inventor: LIN C

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20030202940	A1	20031030	US 2001811316	A	20010316	200406 B
			US 2003425360	A	20030429	

Priority Applications (No Type Date): US 2001811316 A 20010316; US 2003425360 A 20030429

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
US 20030202940	A1		5	A61K-049/00	Div ex application US 2001811316 Div ex patent US 6579511

**Assessment of concentration of compound, e.g. inhalation compound in brain of subject involves administering gas containing compound into subject to fill pulmonary functional residual capacity**

Abstract (Basic):

- ... **Concentration** of compound in the brain of a subject is assessed by administering gas containing compound into subject to fill **pulmonary functional residual capacity**.
- ... Assessment of **concentration** of compound in the brain of a subject involves administering a gas containing the compound into a subject to fill the **pulmonary functional residual capacity**; after having filled the functional residual capacity with the gas, **measuring** an inspired compound **concentration** ( $C_i'$ ) and an expired compound **concentration** ( $C_e'$ ); assessing a mixed venous compound **concentration** ( $C_b'$ ) based on formula  $C_b' = (C_i'(M-1) + C_e')/M$ ; and assessing a compound **concentration** in the brain ( $C_b$ ) based on formula  $C_b = (C_e' + C_b')/2$ ...
- ...medium that stores machine-executable instructions that causing a machine to receive values representing the **concentration** of a compound administered in a gas into a subject to fill the **pulmonary functional residual capacity**; and output a representation of a compound **concentration** in the brain; and...
- ...b) an apparatus comprising a display; and a processor configured to receive values representing the **concentration** of a compound administered in a gas into a subject to fill the **pulmonary functional residual capacity**; and control the display to depict a representation of a compound **concentration** in the brain...
- ...For assessing the **concentration** of compound, e.g. **inhalation** compound in the brain of a subject...

16 MAR  
2001

...The invented **method** is effective in assessing the depth of **anesthesia**

Technology Focus:

... Preferred **Method** : The M is assessed based on formula  
 $M=1-(C_e'/C_i')$ , where  $C_i'$  and  $C_e'$  are inspired compound **concentration**  
and an expired compound **concentration**, respectively, **measured** at  
the time when 90% of the functional residual capacity is filled with  
the gas...

...Preferred Compound: The compound is **anesthetic**. The **anesthetic** is  
isoflurane, haloflurane, desflurane, sevoflurane, or enflurane.

International Patent Class (Additional): **A61B-005/00** ...

30/3,K/16

DIALOG(R)File 350:Derwent WPIX

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015780425 \*\*Image available\*\*

WPI Acc No: 2003-842627/200378

XRFX Acc No: N03-673270

Respiratory training apparatus for pulmonary function testing, has valve that dynamically controls respiratory gas flow, and flow rate monitoring device positioned in flow path of respiratory gas

Patent Assignee: UNIV LELAND STANFORD JUNIOR (STRD )

Inventor: KALAYJIAN N R; ROBINSON T E; WHITE W C

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6631716	B1	20031014	US 9893214	P	19980717	200378 B
			US 99354627	A	19990716	

Priority Applications (No Type Date): US 9893214 P 19980717; US 99354627 A 19990716

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
US 6631716	B1	19	A61M-016/00	Provisional application US 9893214	

Respiratory training apparatus for pulmonary function testing, has valve that dynamically controls respiratory gas flow, and flow rate monitoring device positioned in flow path of respiratory gas

Abstract (Basic):

... The apparatus has a **respiratory** function valve (22) that dynamically controls a gas flow for a patient (30). A monitoring device is positioned in a flow path of **respiratory** gas in fluidic communication with valve for measuring a flow rate of **respiratory** gas. A control unit electrically connected to flow rate monitoring device and the valve, is...

... The control unit receives flow rate data from the monitoring device and dynamically **determines** patient **lung volume** data at each of patient **lung volumes** in a **breathing** cycle. The valve is controlled to apply **respiratory** training resistive load patterns to **respiratory** gas flow according to the **lung volume** data. An INDEPENDENT CLAIM is also included for a **respiratory** training method for performing **respiratory** training on a patient...

...Used for performing **respiratory** muscle training on patients for pulmonary function testing, CT and MRI imaging of chest, combined...

...The apparatus dynamically and accurately controls patients **respiratory** function and also allows substantial flexibility in the **evaluation process** . The apparatus limits patients discomfort during **respiratory** function control procedures and also allows limiting the range of motion of the patients organs...

...The drawing shows a **respiratory** control system...

... **Breathing** conduits (32

Title Terms: **RESPIRATION** ;

International Patent Class (Main): **A61M-016/00**



30/3,K/20

DIALOG(R)File 350:Derwent WPIX

(c) 2004 Thomson Derwent. All rts. reserv.

015597152      \*\*Image available\*\*

WPI Acc No: 2003-659307/200362

XRFX Acc No: N03-525602

**Airway pressure ventilator parameter setting method for lung disorder treatment, involves monitoring airway pressure flow and volume to calculate ventilation duration parameter**

Patent Assignee: HABASHI N M (HABA-I)

Inventor: HABASHI N M

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20030111078	A1	20030619	US 2001299928	P	20010621	200362 B
			US 2002176710	A	20020620	

Priority Applications (No Type Date): US 2001299928 P 20010621; US 2002176710 A 20020620

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

US 20030111078 A1 16 A61M-016/00 Provisional application US 2001299928

**Airway pressure ventilator parameter setting method for lung disorder treatment, involves monitoring airway pressure flow and volume to calculate ventilation duration parameter**

Abstract (Basic):

... The **ventilator** is placed in airway pressure release **ventilation** mode, and the saturation of blood and **carbon dioxide** levels, ratio of spontaneous to machine minute **ventilation**, level of sedation are **measured** invasively or non- invasively. The **ventilator** duration is **calculated** based on airway pressure, flow and volume. Initial settings are established using empiric values based...

... For setting parameters such as **positive end expiratory pressure** ( **PEEP** ), continuous positive airway pressure (CPAP), **ventilation** duration of airway pressure release **ventilation** (APRV) for treatment of lung disorder...

...Increases vent free days, lowers **ventilator** - related drug cost, reduced **ventilator** associated complications, likelihood of high **volume lung** injury and low **volume lung** injury...

...The figure shows a flowchart explaining the airway pressure **ventilator** parameter setting **method**.

...Title Terms: **VENTILATION** ;

International Patent Class (Main): **A61M-016/00**

30/3,K/23

DIALOG(R)File 350:Derwent WPIX

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015505766 \*\*Image available\*\*

WPI Acc No: 2003-567913/200353

Related WPI Acc No: 2002-088736; 2002-706660

XRPX Acc No: N03-451560

Respiration function measurement method for treating chronic obstructive pulmonary disease, involves comparing change in lung volume during breathing with airflow through respiratory system during change in lung flow

Patent Assignee: TUFTS COLLEGE (TUFT )

Inventor: HOFFMAN A

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20030100843	A1	20030529	US 99298352	A	19990423	200353 B
			US 2001950318	A	20010910	
			US 2002237552	A	20020909	

23  
APRIL  
1999

Priority Applications (No Type Date): US 2002237552 A 20020909; US 99298352

A 19990423; US 2001950318 A 20010910

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
US 20030100843	A1	100	A61B-005/08	CIP of application US 99298352 CIP of application US 2001950318 CIP of patent US 6287264

Respiration function measurement method for treating chronic obstructive pulmonary disease, involves comparing change in lung volume during breathing with airflow through respiratory system during change in lung flow

Abstract (Basic):

... organism is placed in a constant volume plethysmograph chamber.  
A signal indicating the change in lung volume during breathing by the living organism is compared with a signal indicating the airflow through the respiratory system of the living organism to calculate the respiratory restriction of the living organism.

... For measuring the respiration function of living organism such as adults, children and animals e.g. canines, to diagnose...

...Provides non-invasive measures of airway obstruction or respiration restriction in the subject and allows the subject to adopt natural body posture for exercise and sports, thereby providing improved process of lmeasuring respiration function of the living organisms...

...The figure shows an explanatory view of the respiration function measuring system .

Title Terms: RESPIRATION ;

International Patent Class (Main): A61B-005/08

30/3,K/24

DIALOG(R)File 350:Derwent WPIX

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015490931

WPI Acc No: 2003-553078/200352

XRFX Acc No: N03-438966

**Method for artificial volume -controlled lung ventilation**

Patent Assignee: NOVOK DOCTORS TRAINING INST (NKDO-R)

Inventor: CHECHENIN M G; CHURLYAEV YU A; MARTYNENKOV V YA; SHULIVEISTROV YU V; VOEVODIN S V

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
RU 2207159	C2	20030627	RU 2001125839	A	20010921	200352	B

Priority Applications (No Type Date): RU 2001125839 A 20010921

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
RU 2207159	C2			A61M-015/00	

**Method for artificial volume -controlled lung ventilation**

Abstract (Basic):

... **Method** involves **calculating** minute inspiratory volume, **breathing** volume, **respiration** frequency, CcalcFcalc with height, age and proper and excessive patient body weight taken into account. The data are entered into **respirator** settings menu and artificial **lung ventilation** is started. **Breathing** volume adjustment is carried out once an hour to reach **breathing** comfort conditions. **Respiration** frequency is adjusted on the basis of capnographic data to reach EtCO2 of 30 mm

... Enhanced effectiveness in achieving normal **ventilation** conditions. 2 cl...

...Title Terms: **VENTILATION**

International Patent Class (Main): **A61M-015/00**

PUBLISHED  
27 JUNE  
2003

FILED

21  
SEP  
2001

30/3,K/30

DIALOG(R)File 350:Derwent WPIX

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015238253 \*\*Image available\*\*

WPI Acc No: 2003-299179/200329

XPX Acc No: N03-237963

**Pulmonary stress assessing method for breathing apparatus, involves determining straight, convex and concave shaped profiles using pressure-volume relationship**

Patent Assignee: SIEMENS-ELEMA AB (SIEI )

Inventor: BLOMBERG U

Number of Countries: 028 Number of Patents: 004

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20020193699	A1	20021219	US 2002171340	A	20020612	200329 B
EP 1269914	A2	20030102	EP 20029069	A	20020423	200336
JP 2003061933	A	20030304	JP 2002179032	A	20020619	200340
US 6718975	B2	20040413	US 2002171340	A	20020612	200425

Priority Applications (No Type Date): SE 20012221 A 20010619

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
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US 20020193699	A1	7	A61B-005/08	
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EP 1269914	A2 E		A61B-005/085	
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Designated States (Regional): AL AT BE CH CY DE DK ES FI FR GB GR IE IT  
LI LT LU LV MC MK NL PT RO SE SI TR

JP 2003061933	A	7	A61B-005/08	
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US 6718975	B2		A61M-016/00	
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**Pulmonary stress assessing method for breathing apparatus, involves determining straight, convex and concave shaped profiles using pressure-volume relationship**

Abstract (Basic):

... A volume of **respiratory** gas is obtained from the lungs of an exhaling patient (6) to measure an ensuring...

...straight, convex or concave shaped profiles corresponding to constant lung compliance, reduction or increase in **lung** compliance using the pressure- **volume** relationship.

... An INDEPENDENT CLAIM is included for **breathing** apparatus...

...For assessing pulmonary stress using **breathing** apparatus (claimed) used for automatic resetting of **positive end expiratory pressure** ( **PEEP** ), tidal volumes, airway pressure, I:E ratio or other **ventilator** controlled parameters...

...The figure shows a schematic diagram of the **breathing** apparatus...

International Patent Class (Main): **A61B-005/08** ...

... **A61B-005/085** ...

... **A61M-016/00**

12 JUNE  
2002

30/3,K/34

DIALOG(R)File 350:Derwent WPIX

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015041768

WPI Acc No: 2003-102284/200309

Related WPI Acc No: 2004-059608

XRAM Acc No: C03-025705

XRPX Acc No: N03-081682

**Assessing concentration of compound e.g. anesthetics in brain, by administering compound in gas to fill pulmonary functional residual capacity and measuring inspired, expired and mixed venous drug concentration based on specified relation**

Patent Assignee: LIN C (LINC-I)

Inventor: LIN C

Number of Countries: 001 Number of Patents: 002

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
US 20020131936	A1	20020919	US 2001811316	A	20010316	200309	B
US 6579511	B2	20030617	US 2001811316	A	20010316	200341	

Priority Applications (No Type Date): US 2001811316 A 20010316

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
US 20020131936	A1		5 A61K-049/00	
US 6579511	B2		A61K-049/00	

**Assessing concentration of compound e.g. anesthetics in brain, by administering compound in gas to fill pulmonary functional residual capacity and measuring inspired, expired and mixed venous drug concentration based on specified relation**

Abstract (Basic):

... **Concentration** of a compound in brain is assessed by administering a gas containing the compound into a subject to fill the **pulmonary functional residual capacity (FRC)**, **measuring** an inspired compound **concentration (Ci')** and expired compound **concentration (Ce')**, assessing mixed venous compound **concentration (Cb')** based on a specified relation including alveolar membrane factor for the compound.

... **Method** of assessing the **concentration** of a compound in brain comprises administering a gas containing the compound to fill the pulmonary FRC, **measuring** an inspired compound **concentration (Ci')** and an expired compound **concentration (Ce')**, assessing a mixed venous compound **concentration (Cb')** based on the formula  $Cb' = (Ci' (M-1) + Ce') / M$  (where M is an alveolar membrane factor for the compound), and assessing a compound **concentration** in the brain (Cb) based on formula  $Cb = (Ce' + Cb') / 2$ ...

...readable medium that stores machine executable instructions causing a machine to receive values representing the **concentration** of a compound administered in a gas to fill the pulmonary FRC, and output Cb

...Used for assessing the **concentration** of an **inhalational** compound (e.g. an **anesthetic**) in the brain of a subject after administration of the compound, to assess the depth of **anesthesia**.

...The **method** allows **determination** of the correlation between an

16 MARCH  
2001

inhalational compound concentration in the brain and the average of an expired compound concentration and a mixed venous concentration, so that, without blood sampling, the concentration of an inhalational compound in the brain can be assessed based on measurements of inspired and expired compound concentrations, providing an objective method for determining the depth of anesthesia. With the measurements of  $C_e'$  and  $C_b'$ , the compound concentration in the brain ( $C_b$ ) is readily obtained

Technology Focus:

... Preferred Method : The values also include a second inspired compound concentration ( $C_i$ ) and a second expired compound concentration ( $C_e$ ), in which  $C_i$  and  $C_e$  are measured at the time when 90% of FRC is filled with the gas, and M is...

...from  $C_i$  and  $C_e$ , monitor a time interval, and trigger the detection to sample the inhalation compound from an inspiration and an expiration after filling FRC with the gas...

...Preferred Compounds: The compound is an anesthetic comprising isoflurane, haloflurane, desflurane, sevoflurane or enflurane.

Extension Abstract:

... a gas containing a desflurane to a patient. A tube was connected to the circle system of an anesthesia machine consisting of gas flow meters, a compound vaporizer, supply of oxygen, air and nitrous oxide gas and a ventilator. The gas was then delivered to the patient by the anesthesia machine. Desflurane was vaporized, taking up 6-8% of the total gas, and delivered at a flow rate of 3000 ml/minute. Near the connection between the circle system and the tube, a side arm sampling site was linked to a gas monitoring equipment

...Desflurane had a membrane factor, M, of 0.2 for most patients. A more precise determination of M was performed at the end of 3 minutes, when 85-95% of the fluid residual capacity was filled with the gas. The inspired desflurane concentration and the expired desflurane concentration of the patient at this time, was measured and the patient's membrane factor M was obtained. If the inspired desflurane concentration was 6% and the expired desflurane concentration was recorded as 4.8% at 3-4 minutes, the patient's membrane factor for...

...Title Terms: ANAESTHETIC ;

International Patent Class (Additional): A61B-005/04 ...

... A61B-005/08

30/3,K/39

DIALOG(R)File 350:Derwent WPIX

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014885954 \*\*Image available\*\*

WPI Acc No: 2002-706660/200276

Related WPI Acc No: 2002-088736; 2003-567913

XRPX Acc No: N02-557212

Respiration path reactivity measuring method for treatment of chronic obstructive pulmonary disease, involves calculating signal indicating respiratory restriction of living organism by processing two input signals

Patent Assignee: TUFTS COLLEGE (TUFT )

Inventor: HOFFMAN A

Number of Countries: 028 Number of Patents: 004

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20020120207	A1	20020829	US 99298352	A	19990423	200276 B
			US 2001950318	A	20010910	
WO 200322149	A2	20030320	WO 2002US28690	A	20020909	200330
US 6723055	B2	20040420	US 99298352	A	19990423	200427
			US 2001950318	A	20010910	
AU 2002336466	A1	20030324	AU 2002336466	A	20020909	200461

Priority Applications (No Type Date): US 2001950318 A 20010910; US 99298352 A 19990423

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
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US 20020120207	A1		76	A61B-005/02	CIP of application US 99298352
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WO 200322149	A2 E			A61B-005/08	
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Designated States (National): AU CA IN JP

Designated States (Regional): AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LU MC NL PT SE SK TR

US 6723055	B2			A61B-005/00	CIP of application US 99298352
					CIP of patent US 6287264

AU 2002336466	A1			A61B-005/08	Based on patent WO 200322149
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Respiration path reactivity measuring method for treatment of chronic obstructive pulmonary disease, involves calculating signal indicating respiratory restriction of living organism by processing two input signals

Abstract (Basic):

... input signals (110,210) obtained from two sensors (100,200) respectively indicate the change in lung volume and the airflow through the respiratory system of a living organism during the change in lung volume. The two input signals are processed so as to calculate a new signal (410) indicating respiratory restriction of the living organism.

... a) Clinical airway obstruction measuring method ; and...

...For measuring respiratory function of living organism, including adults, infants, children and conscious animal such as canines for diagnosis and treatment of respiratory conditions and diseases e.g. chronic obstructive pulmonary disease, asthma, apnea, dyspnea and emphysema...

...Provides non-invasive measures of airway obstruction or respiration restriction in the living organism. Permits real time analysis using several measured variables to access respiratory function. Enables detecting increase in respiratory system impedance by measuring

23 APRIL  
1999

gas compression or expansion indirectly, using non-invasive sensors, by providing signal indicative of **respiration** restriction of the organism...

...The figure shows a top level flow diagram illustrating the **respiratory** function **measuring** **method** .

Title Terms: **RESPIRATION** ;

International Patent Class (Main): **A61B-005/00** ...

... **A61B-005/02** ...

... **A61B-005/08**



30/3,K/40

DIALOG(R)File 350:Derwent WPIX

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014562452 \*\*Image available\*\*

WPI Acc No: 2002-383155/200241

XRFX Acc No: N02-299950

**Device for rapidly determining lung diffusion capacity measures helium concentration by measuring transition times of ultrasonic pulses between two ultrasonic transmitter/receivers**

Patent Assignee: GANSHORN P (GANS-I)

Inventor: GANSHORN P

Number of Countries: 019 Number of Patents: 002

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 200224070	A1	20020328	WO 2000DE3281	A	20000920	200241 B
DE 10085180	T	20031120	DE 1085180	A	20000920	200378
			WO 2000DE3281	A	20000920	

Priority Applications (No Type Date): WO 2000DE3281 A 20000920

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

WO 200224070 A1 G 21 A61B-005/08

Designated States (National): DE US

Designated States (Regional): AT BE CH CY DE DK ES FI FR GB GR IE IT LU

MC NL PT SE

DE 10085180 T A61B-005/08 Based on patent WO 200224070

**Device for rapidly determining lung diffusion capacity measures helium concentration by measuring transition times of ultrasonic pulses between two ultrasonic transmitter/receivers**

Abstract (Basic):

... The device **measures** the **concentration** of carbon monoxide and **helium** in the air **breathed** in and out. It **measures helium concentration** by **measuring** transition times of ultrasonic pulses between two ultrasonic transmitter/receivers, especially piezoelectric ultrasonic transmitter/receivers. The time is **measured** from the charge on a capacitor accrued during the transition.

... For rapidly **determining lung diffusion capacity** and diffusion **capacity** distribution anomalies...

...Enables rapid continuous **measurement** of **helium concentration** .

...

...The drawing shows a schematic sectional perspective exploded block diagram representation of an arrangement for **determining lung diffusion capacity** and diffusion **capacity** distribution anomalies (Drawing includes non-English text

...Title Terms: **DETERMINE** ;

International Patent Class (Main): A61B-005/08

PUBLISHED  
28 MARCH  
2002  
FILED  
20  
SEPT  
2000

30/3,K/41

DIALOG(R)File 350:Derwent WPIX

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014552288 \*\*Image available\*\*

WPI Acc No: 2002-372991/200241

XRAM Acc No: C02-105667

XRPX Acc No: N02-291459

**Method of determining functional residual capacity of lungs during breathing , useful in newly-born or premature babies and for determining intra-pulmonal gas distribution disorders, employs fluoro - propane**

Patent Assignee: DRAEGER MEDICAL & CO AG KGAA (DRAE-N); DRAGER

MEDIZINTECHNIK GMBH (DRAG-N); ANKERHOLD G (ANKE-I); HATTENDORFF H

(HATT-I); KOCH J (KOCH-I); WEISMANN D (WEIS-I); DRAEGER MEDIZINTECHNIK GMBH (DRAE-N)

Inventor: ANKERHOLD G; HATTENDORFF H; KOCH J; WEISMANN D; HATTENDORFF H D; HATTENDORFF H

Number of Countries: 003 Number of Patents: 005

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
DE 10046465	A1	20020404	DE 10046465	A	20000920	200241 B
FR 2816512	A1	20020517	FR 200112061	A	20010918	200241
US 20020052560	A1	20020502	US 2001902905	A	20010711	200241
US 6544191	B2	20030408	US 2001902905	A	20010711	200327
DE 10046465	B4	20040805	DE 10046465	A	20000920	200451

Priority Applications (No Type Date): DE 10046465 A 20000920

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
DE 10046465	A1		8	A61K-049/00	
FR 2816512	A1			A61K-049/00	
US 20020052560	A1			A61B-005/08	
US 6544191	B2			A61B-005/08	
DE 10046465	B4			A61K-049/00	

**Method of determining functional residual capacity of lungs during breathing , useful in newly-born or premature babies and for determining intra-pulmonal gas distribution disorders, employs fluoro - propane**

Abstract (Basic):

... A **method** (I) of **determining functional residual capacity** of the **lungs** comprising the use of **fluoro - propane**, (II).  
... Preferred **Method** : (I) comprises...

...1) production of a predetermined **concentration** of **fluoro - propane** in the lungs by flushing them to saturation...

...2) **measurement** of **fluoro - propane** /volumes (V1 - Vn) in expired gases for successive **breaths** (A=1 - n) in subsequent flushing-out phases, using a sensor (14...

...3) **determination** of the corresponding **concentrations** K1 - Kn of **fluoro - propane** in each **breath** , using a computer...

...4) **determination** of the time of **breathing** the mean **concentration** of **fluoro - propane** is multiplied by the relevant volumes...

...5) **calculating** a value for the functional residual capacity (FRC), the quotient of the **calculated** , expired volume of **fluoropropane** and the difference between the **fluoropropane concentration** K0 at the start of the flushing-out phase and that KA during the **breath** A; and...

...the result FRC lies in a given band of tolerance, 5-20% of the last  
calculated value FRCn...

...I) is used to determine the functional residual capacity of the  
lungs during breathing. The method determines lung state, e.g.  
in premature and newly-born babies and is useful for following the  
effectiveness of therapy. Intra-pulmonal gas distribution disorders can  
be quantified at the same time...

...Infra red optical analyzers are suitable for measurement in the  
waveband 3  $\mu\text{m}$  -10  $\mu\text{m}$ . gas...

... Fluoropropane source (6...

... Breathing unit (16

Technology Focus:

... The fluoro - propane is heptafluoropropane ,  
hexafluoropropane or perfluoropropane .

Title Terms: METHOD ;

International Patent Class (Main): A61B-005/08 ...

International Patent Class (Additional): A61M-016/00 ...

30/3,K/42

DIALOG(R)File 350:Derwent WPIX

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014472915 \*\*Image available\*\*

WPI Acc No: 2002-293618/200234

XRPX Acc No: N02-229154

**Gas supply system for a breathing apparatus, has an adapter at the gas bottle valve for an additional test gas supply to measure the patient's residual lung capacity**

Patent Assignee: DRAEGER MEDICAL & CO AG KGAA (DRAE-N); KOCH J (KOCH-I)

Inventor: KOCH J

Number of Countries: 002 Number of Patents: 003

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
DE 10109671	C1	20020502	DE 1009671	A	20010228	200234 B
US 20020050275	A1	20020502	US 200125141	A	20011219	200234
US 6578573	B2	20030617	US 200125141	A	20011219	200341

Priority Applications (No Type Date): DE 1009671 A 20010228

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
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DE 10109671	C1	7	A61M-016/00		
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US 20020050275	A1		A62B-007/00		
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US 6578573	B2		A62B-009/04		
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**Gas supply system for a breathing apparatus, has an adapter at the gas bottle valve for an additional test gas supply to measure the patient's residual lung capacity**

Abstract (Basic):

... The gas supply **system**, to deliver an additional gas for a **breathing** apparatus, has an adapter (1) to attach the gas bottle (2) to the collar (5...

...the gas bottle, and it has a nominal fracture point (17) so that the ratchet **system** is destroyed when the adapter is detached from the collar. The connector is a bayonet...

... The gas supply is for a **breathing** apparatus, where an additional test gas is used to **measure** the patient's residual **lung capacity** e.g. **helium** or **heptafluoropropane**.

...The **system** gives an additional gas supply, which is easily fitted using the adapter with a conventional

...Title Terms: **SYSTEM**;

International Patent Class (Main): **A61M-016/00** ...

International Patent Class (Additional): **A61M-016/12**

19 DEC  
2001

30/3,K/43

DIALOG(R)File 350:Derwent WPIX

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014417928 \*\*Image available\*\*

WPI Acc No: 2002-238631/200229

XRPX Acc No: N02-183898

**Non-invasive, anatomical deadspace volume measuring apparatus,  
measures flow rate of exhaled gas and concentration of constituents in  
exhaled gas**

Patent Assignee: RESPIRONICS INC (RESP-N); STARR E W (STAR-I)

Inventor: STARR E W

Number of Countries: 024 Number of Patents: 004

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 20010049478	A1	20011206	US 2000209284	P	20000602	200229 B
			US 2001864806	A	20010524	
AU 200165072	A	20011217	AU 200165072	A	20010525	200229
WO 200193761	A1	20011213	WO 2001US17223	A	20010525	200229
US 6599252	B2	20030729	US 2000209284	P	20000602	200354
			US 2001864806	A	20010524	

Priority Applications (No Type Date): US 2000209284 P 20000602; US  
2001864806 A 20010524

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
US 20010049478	A1		10	A61B-005/08	Provisional application US 2000209284

AU 200165072 A A61B-005/08 Based on patent WO 200193761

WO 200193761 A1 E A61B-005/08

Designated States (National): AU BR CA JP

Designated States (Regional): AT BE CH CY DE DK ES FI FR GB GR IE IT LU

MC NL PT SE TR

US 6599252 B2 A61B-005/08 Provisional application US 2000209284

**Non-invasive, anatomical deadspace volume measuring apparatus,  
measures flow rate of exhaled gas and concentration of constituents in  
exhaled gas**

Abstract (Basic):

... Sensor (4) **measures** the flow rate of gas exhaled through an interface (10) such as nasal mask. A gas analyzer (6) **measures** the **concentration** of oxygen, **carbon dioxide** in the exhaled gas. A controller (14) **determines** the volume of the anatomical deadspace by deriving inflection points in gas constituent **concentration** waveform produced based on the flow rate and the gas constituents.

... An INDEPENDENT CLAIM is also included for anatomical deadspace volume **measurement method**.

...For **measuring** anatomical deadspace volume for controlling medical **ventilator**.

...The accurate and repeated **determination** of the anatomical deadspace volume of a patient, enables control of medical **ventilators** to fill the total **lung volume** with **breathing gas**, without discomfort to patient and also reducing the risk of pulmonary trauma...

...The figure shows the block diagram of the deadspace volume **measuring apparatus**

2 JUNE  
2000

...Title Terms: **MEASURE** ;

International Patent Class (Main): **A61B-005/08**

30/3,K/44

DIALOG(R)File 350:Derwent WPIX

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014376227 \*\*Image available\*\*

WPI Acc No: 2002-196930/200226

XRPX Acc No: N02-149506

**Functional residual lung capacity measuring method using tracer  
gas principle with perfluorocarbon as tracer**

Patent Assignee: UNIV DRESDEN TECH (UYDR )

Inventor: ALBRECHT D M; GAMA DE ABREU M; WINKLER T

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
DE 10038818	A1	20020221	DE 1038818	A	20000804	200226 B

Priority Applications (No Type Date): DE 1038818 A 20000804

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
DE 10038818	A1	8	A61B-005/091	

**Functional residual lung capacity measuring method using tracer  
gas principle with perfluorocarbon as tracer**

Abstract (Basic):

... The **measuring method** has a perfluorocarbon, which is stored in its liquid phase and used in its gas phase as the tracer for **measurement** of the functional residual **lung capacity** via a tracer principle. The component of the tracer gas within the **respiration** gas volume is between 0.1 and 5 %....

... An INDEPENDENT CLAIM for a functional residual **lung capacity measuring** device is also included...

...The **measuring method** is used for **determining** the functional residual **lung capacity** for clinical routine monitoring or **lung** function diagnosis...

...The use of perfluorocarbon as the tracer gas has a minimum effect on normal **respiration** .

...The figure shows a schematic representation of a functional residual **lung capacity measuring** device with perfluorocarbon used as the tracer gas in an open system. (Drawing includes non International Patent Class (Main): **A61B-005/091**

PUBLISHED  
21 FEB  
2002  
FILED  
4  
AUG  
2000

30/3,K/47

DIALOG(R)File 350:Derwent WPIX

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014268083 \*\*Image available\*\*

WPI Acc No: 2002-088781/200212

XRPX Acc No: N02-065376

**Residual lung volume of infants measurement method for clinical and research studies of lung function, involves switching infant's inspired air to pure oxygen or gaseous mixture containing inert gas**  
Patent Assignee: ARKANSAS CHILDRENS HOSPITAL RES INST INC (ARKA-N); UNIV ARKANSAS (UYAR-N)

Inventor: MORRIS M G

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6306099	B1	20011023	US 2000506147	A	20000217	200212 B

Priority Applications (No Type Date): US 2000506147 A 20000217

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
US 6306099	B1	24	A61B-005/08	

**Residual lung volume of infants measurement method for clinical and research studies of lung function, involves switching infant's inspired air to pure oxygen or gaseous mixture containing inert gas**

Abstract (Basic):

... residual volume (RV). The infant's inspired air is switched to 100% oxygen if using **nitrogen** washout or to a gaseous mixture containing **inert gas**. Upon resumption of spontaneous **respiration**, thoracoabdominal compression is terminated and remaining gas in the lung is **measured** by **inert gas** washout or dilution.

... An INDEPENDENT CLAIM is also included for forced vital **capacity** and residual **lung volume (RV) measurement method**.

...

...Used for routine clinical and research studies of lung function of infants to **determine** efficacy of therapeutic interventions and to **evaluate** relation between lung injury and chronic lung disease and also used in experimental animal studies...

...Provides a non-invasive **technique** used for reproducible routine **measurement** of RV by **nitrogen** washout in infants...

...The figure shows a schematic view of **nitrogen** washout circuit

...Title Terms: **MEASURE** ;

International Patent Class (Main): **A61B-005/08**



30/3,K/48

DIALOG(R)File 350:Derwent WPIX

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014268038     \*\*Image available\*\*

WPI Acc No: 2002-088736/200212

Related WPI Acc No: 2002-706660; 2003-567913

XRFX Acc No: N02-065338

Respiratory function measurement method for living organism,  
involves comparing signals indicating change in lung volume and air  
flow through respiratory tract to generate signal indicating  
respiratory restriction

Patent Assignee: TUFTS COLLEGE (TUFT )

Inventor: HOFFMAN A

Number of Countries: 001    Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 6287264	B1	20010911	US 99298352	A	19990423	200212 B

Priority Applications (No Type Date): US 99298352 A 19990423

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
US 6287264	B1	51	A61B-005/02	

Respiratory function measurement method for living organism,  
involves comparing signals indicating change in lung volume and air  
flow through respiratory tract to generate signal indicating  
respiratory restriction

Abstract (Basic):

...     The signals obtained from two sensors to respectively indicate a  
change in a **lung volume** and an air flow through the **respiratory**  
tract during the variation of **lung volume** , are compared to generate  
a signal indicating the **respiratory** restriction of the living  
organism.

...     An INDEPENDENT CLAIM is also included for **respiratory** function  
**measurement system** .

...

...For measuring **respiratory** function of living organisms...

...Permits real-time analysis of several measured variables to assess  
**respiratory** function. Provides non-invasive measurement of airway  
obstruction or **respiration** restriction in subjects. Monitors response  
to treatment such as bronchodilators...

...The figure shows the block diagram of **respiratory** function  
**measurement system** .

Title Terms: **RESPIRATION** ;

International Patent Class (Main): **A61B-005/02**

23 APRIL  
1999

30/3,K/56

DIALOG(R)File 350:Derwent WPIX

(c) 2004 Thomson Derwent. All rts. reserv.

013957411 \*\*Image available\*\*

WPI Acc No: 2001-441625/200147

XRAM Acc No: C01-133395

XRFX Acc No: N01-326697

**Gas supply system for the inhalative treatment of humans and mammals suffering from asthma and chronic obstructive pulmonary disease has an inspired- volume -dependent controlled dosage of at least one gas**

Patent Assignee: MESSER AUSTRIA GMBH (MESG ); MUELLNER R (MUEL-I)

Inventor: MUELLNER R

Number of Countries: 021 Number of Patents: 004

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 200143806	A2	20010621	WO 2000EP12246	A	20001206	200147 B
DE 19961206	A1	20010705	DE 1061206	A	19991218	200147
EP 1239911	A2	20020918	EP 2000993379	A	20001206	200269
			WO 2000EP12246	A	20001206	
US 20030172929	A1	20030918	WO 2000EP12246	A	20001206	200362
			US 2002149616	A	20021023	

Priority Applications (No Type Date): DE 1061206 A 19991218

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

WO 200143806 A2 G 15 A61M-016/12

Designated States (National): US

Designated States (Regional): AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE TR

DE 19961206 A1 A61M-016/00

EP 1239911 A2 G A61M-016/12 Based on patent WO 200143806

Designated States (Regional): AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR

US 20030172929 A1 A61M-016/00

**Gas supply system for the inhalative treatment of humans and mammals suffering from asthma and chronic obstructive pulmonary disease has an inspired- volume -dependent controlled dosage of at least one gas**

Abstract (Basic):

... An INDEPENDENT CLAIM is also included for a process for operating gas supply **systems** comprising **determining a breath volume curve** using a sensor and carrying out a controlled gas dosage depending on the...

...For the **inhalative** treatment of humans and mammals, especially patients with asthma and chronic obstructive pulmonary disease (claimed

Technology Focus:

... The gas supply system contains an additional gas line (6) with a sensor (8) for **measuring the breath pressure or breath flow**.

International Patent Class (Main): A61M-016/00 ...

... A61M-016/12

*see  
claims  
in  
"V5"  
VERSION*

30/3,K/58

DIALOG(R)File 350:Derwent WPIX

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013897247 \*\*Image available\*\*

WPI Acc No: 2001-381460/200140

XRAM Acc No: C01-116862

XRPX Acc No: N01-279718

Determining compartmentalized lung relationships such as tidal or alveolar volumes, perfusion/ventilation /volume ratios comprises using  $F_{exp}(\lambda, n) - (F_{bolus}/V_t) \sum V_{ti}(x_i, y_i, \lambda, n)$

Patent Assignee: INSTRUMENTARIUM CORP (INST-N)

Inventor: VIERTIOE-OJA H; VIERTO-OJA H

Number of Countries: 095 Number of Patents: 004

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 200141641	A1	20010614	WO 2000IB1822	A	<del>20001130</del>	200140
US 6254546	B1	20010703	US 99457065	A	<del>19991207</del>	200140
AU 200115449	A	20010618	AU 200115449	A	20001130	200161
EP 1150607	A1	20011107	EP 2000977818	A	20001130	200168
			WO 2000IB1822	A	20001130	

Priority Applications (No Type Date): US 99457065 A 19991207

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

WO 200141641 A1 E 42 A61B-005/08

Designated States (National): AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG UZ VN YU ZA ZW

Designated States (Regional): AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW MZ NL OA PT SD SE SL SZ TR TZ UG ZW

US 6254546 B1 A61B-005/08

AU 200115449 A A61B-005/08 Based on patent WO 200141641

EP 1150607 A1 E A61B-005/08 Based on patent WO 200141641

Designated States (Regional): AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT RO SE SI

Determining compartmentalized lung relationships such as tidal or alveolar volumes, perfusion/ventilation /volume ratios comprises using  $F_{exp}(\lambda, n) - (F_{bolus}/V_t) \sum V_{ti}(x_i, y_i, \lambda, n)$

Abstract (Basic):

... **Determining** (M1) a relationship in lung compartments, with at least one characteristic relating to tidal volume ( $V_{ti}$ ), alveolar volume ( $V_{ai}$ ), or perfusion (Q) distributions, or **ventilation** /perfusion ( $V_t/Q$ ), **ventilation** /volume ( $V_t/V_a$ ), or perfusion/volume ( $Q/V_a$ ) ratios, comprises expressing them in a form

... M1 involves **determining** a distributive relationship in the lungs of a subject, where the distribution occurs among several...

...one characteristic relating to tidal volume ( $V_{ti}$ ), alveolar volume ( $V_{ai}$ ), or perfusion (Q) distributions, or **ventilation** /perfusion ( $V_t/Q$ ), **ventilation** /volume ( $V_t/V_a$ ), or perfusion/volume ( $Q/V_a$ ) ratios, comprising...

...causing the subject to inspire a bolus of analytical gases in a tidal volume of **breathing gases**, where the analytical gases have different solubilities in blood and are inspired in known **amounts** ;  
(...)

...ii) **measuring** analytical gas **concentrations** in the expired **breathing gases** for at least one **breath** ;  
 (...)

...iii) expressing the expired **concentrations** of analytical gases in a form:  $F_{exp}(\lambda, n) = (F_{bolus}/V_{t2}) \sum V_{ti} g(x_i, y_i, \lambda)$ ...

...b)  $F_{exp}$  = expired analytical gas **concentration** ;  
 (...)

...j)  $n$  = **breath** number; and...

...k)  $\Delta t$  = duration of **breath** ;  
 (...)

...An INDEPENDENT CLAIM is also included for **determining** (M2) the distribution of  $V_t$  of gases inspired by a subject into his/her lungs...

...the subject inspire a bolus of analytical gases with different blood solubilities and known inspired **amounts** in a tidal volume of **breathing gases** ;  
 (...)

...b) **measuring concentrations** of the analytical gases in the expired **breathing gases** for at least one **breath** ;  
 (...)

...c) expressing the expired **concentrations** of analytical gases in a form:  $F_{exp}(\lambda, n) = (V_{bolus}/V_{t2}) \sum V_{ti} g(x_i, y_i, \lambda)$ ...

...The **method** is used to **determine** a relationship in the compartments of the lungs of a subject (claimed). This can be...

...Prior **methods** such as the MIGET, were very laborious and invasive. They were not amenable to **determining** certain lung characteristics. They did not give information regarding the **ventilation** per unit gas volume and its distribution characteristics. The MIGET could not **determine** such diagnostic information such as **pulmonary tissue volume** and **amount** of water in the lungs since, in steady state, these only act as static storages...

...The figure shows a flow chart describing the **method** of the invention

Technology Focus:

... Preferred **Method** : Step (d) in M1 is further defined as setting the compartmental  $V_{ti}/Q_i$  and  $V_{ti}$ ...

...at least one extremum value can be obtained by application of an appropriate constraint, the **method** being further defined as obtaining a minimum extremum value and solving (II) as obtaining several...

...positive, is dependent on the modified Maxwell-Boltzmann function. Function E is minimized using the **method** of Lagrange multipliers. M2 further comprises **ascertaining** at least one of the functional residual **capacity** (FRC) of the **lungs** of the subject and the pulmonary blood flow (Q) of the subject where a weight factor in the **method** of Lagrange multipliers relates to FRC and/or pulmonary blood flow; (II) is solved using...

...present on healthy lungs.  $x_i$  is a constant and the compartments occupy a range of **ventilation** /perfusion ratio ( $V_t/Q$ ) values, or  $y_i$  is a constant and the compartments occupy a range of **ventilation** /volume ratio ( $V_t/V_a$ ) values, or both  $x_i$  and  $y_i$  are variables and the

Compare to  
 Claim  
 "1"  
 in  
 10/650114

compartments...

...solubilities in a desired range, preferably from 0.05 to more than 10. Expired gas **concentrations** are **measured** in several **breaths**, preferably before recirculation of the blood. M2 further includes **determining** the magnitude of pulmonary blood flow from the  $V_t$  of the distribution and from  $V_t/Q$  ratios. FRC is **determined** using expired **concentration measurements** of one of the analytical gases. **Amounts** of **pulmonary tissue volume** and **lung water** are **determined** using expired **concentrations** of the analytical gases. Correction is provided for anatomical dead spaces in the subject. M2 further comprises **measuring** the functional residual **capacity** of the **lungs** before step (c) and solving (II) using a Monte Carlo simulation and satisfying  $V_t$ =more...

...Preferred Gases: The gases are **SF<sub>6</sub>**, **NO**, **N<sub>2</sub>O**, **(CH<sub>3</sub>)<sub>2</sub>O**, **CH<sub>3</sub>OCH<sub>3</sub>**, **CH<sub>2</sub>**, **CO<sub>2</sub>** and fluorated hydrocarbons (HFC) 125, 134a, 152a, 227ea, and 32.

Title Terms: **DETERMINE** ;

International Patent Class (Main): **A61B-005/08**

International Patent Class (Additional): **A61B-005/091**

30/3,K/68

DIALOG(R)File 350:Derwent WPIX

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013376837 \*\*Image available\*\*

WPI Acc No: 2000-548775/200050

XRAM Acc No: C00-163737

XRPX Acc No: N00-406017

Determining pulmonary functional capacity of critically ill or  
artificially ventilated patients by calculation from amount of  
indicator gas inhaled and exhaled in given time or set of breaths

Patent Assignee: INSTRUMENTARIUM CORP (INST-N); INSTRUMENTARIUM OY (INST-N)

Inventor: HEINONEN E

Number of Countries: 022 Number of Patents: 003

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 200044280	A1	20000803	WO 2000IB71	A	20000125	200050
US 6139506	A	20001031	US 99240722	A	19990129	200057
EP 1065973	A1	20010110	EP 2000900768	A	20000125	200103
			WO 2000IB71	A	20000125	

B

29 JAN  
1999

Priority Applications (No Type Date): US 99240722 A 19990129

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

WO 200044280 A1 E 35 A61B-005/091

Designated States (National): CA JP

Designated States (Regional): AT BE CH CY DE DK ES FI FR GB GR IE IT LU  
MC NL PT SE

US 6139506 A A61B-005/08

EP 1065973 A1 E A61B-005/091 Based on patent WO 200044280

Designated States (Regional): AT BE CH CY DE DK ES FI FR GB GR IE IT LI  
LU MC NL PT SE

Determining pulmonary functional capacity of critically ill or  
artificially ventilated patients by calculation from amount of  
indicator gas inhaled and exhaled in given time or set of breaths

Abstract (Basic):

... The functional residual pulmonary capacity (FRC) of a  
patient is determined by adding indicator gas into breathing gas  
(es) delivered to a patient. The amounts of indicator gas delivered  
(SIGMA VIn) and exhaled (SIGMA Vout) in a given breath and a number  
of preceding breaths are summed separately as is the amount of the  
indicator gas exhaled in the same breaths. This is used to indicate  
the concentration of the indicator gas (FET) in the lungs during  
these breaths. FRC is calculated from  $SIGMA VIn = FET \times FRC + SIGMA$   
Vout  $\times K$  where FRC and K are...

... An INDEPENDENT CLAIM is included for the following: (a) A  
modification of the above method replaces SIGMA VIn and SIGMA Vout  
with the amount of gas delivered and exhaled in a given time period  
and FET with a differential concentration of the gas in the lungs  
during this period (DELTA FET). Preferred Features: K and FRC are  
determined by a multi-stage regression analysis using least squares.  
The indicator gas is delivered to the patient until FET remains  
constant between breaths. Alternatively the gas is delivered for only  
the first of the breaths. Alternatively different amounts of the  
gas are delivered during the breaths. Alternatively a dose of the gas  
is delivered over the breaths.

... Determining pulmonary functional capacity of critically ill or

artificially ventilated patients...

...The breathing regimen of the patient is disturbed minimally...

... breathing tube (12...

... respirator (14...

... inhalation limb (16

Technology Focus:

... The indicator gas is sulphur hexafluorine and forms at most 0.5  
% of the breathing gas (es).

Title Terms: DETERMINE ;

International Patent Class (Main): A61B-005/08 ...

... A61B-005/091

30/3,K/75

DIALOG(R)File 350:Derwent WPIX

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012869483 \*\*Image available\*\*

WPI Acc No: 2000-041316/200004

XPX Acc No: N00-031361

Determination method for the volumetric capacity of interconnecting tubing in patient respiratory system

Patent Assignee: SIEMENS-ELEMA AB (SIEI )

Inventor: HOEGNELID K; SKOG G

Number of Countries: 027 Number of Patents: 005

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
EP 965356	A1	19991222	EP 99107465	A	19990429	200004 B
JP 2000005311	A	20000111	JP 99165617	A	19990611	200013
US 6253765	B1	20010703	US 99333619	A	19990615	200140
EP 965356	B1	20030625	EP 99107465	A	19990429	200349
DE 69909023	E	20030731	DE 609023	A	19990429	200357
			EP 99107465	A	19990429	

Priority Applications (No Type Date): SE 982122 A 19980615

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

EP 965356 A1 E 9 A61M-016/00

Designated States (Regional): AL AT BE CH CY DE DK ES FI FR GB GR IE IT LI LT LU LV MC MK NL PT RO SE SI

JP 2000005311 A 6

US 6253765 B1 A61M-016/00

EP 965356 B1 E A61M-016/00

Designated States (Regional): DE FR

DE 69909023 E A61M-016/00 Based on patent EP 965356

Determination method for the volumetric capacity of interconnecting tubing in patient respiratory system

Abstract (Basic):

... The **determination method** is carried out when the flow of patient **breathing** air/gas is virtually zero. A predetermined flow of gas is added to the system, whilst maintained at constant pressure. When added gas starts to flow out of the **system**, its volume may be **determined** from the out-flowing gas marker', enabling assessment of the volume of gas which has...

... For assessing volumetric capacity of interconnecting tubing system in **respiratory** care while a patient is connected, enabling exclusion of the **volume** of the patient airway and **lungs**.

...efficiently determines total elastic volume of interconnecting tubing system, while the patient is connected for **ventilation** but during **breathing** pauses during **respiration**.

...Figure of a diagram illustrating the **breathing** cycle of a patient

...Title Terms: **RESPIRATION** ;

International Patent Class (Main): A61M-016/00

SEE  
CLAIMS  
IN  
"US"  
VERSION,  
PARTICULARLY  
THE  
ONES  
DESCRIBING  
"SECOND  
GAS"  
AND  
"TRACE  
GAS"



30/3,K/77

DIALOG(R)File 350:Derwent WPIX

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012734368 \*\*Image available\*\*

WPI Acc No: 1999-540485/199945

XRFX Acc No: N99-400624

Method for gating therapeutic or diagnostic energy to tissue volume of medical patient during respiratory cycle

Patent Assignee: ST JUDE CHILDREN'S RES HOSPITAL (SJUD-N)

Inventor: BURNHAM B H; SONTAG M R

Number of Countries: 082 Number of Patents: 003

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 9943260	A1	19990902	WO 99US4150	A	19990225	199945 B
AU 9933120	A	19990915	AU 9933120	A	19990225	200004
US 6076005	A	20000613	US 9875990	A	19980225	200035
			US 98129812	A	19980806	

Priority Applications (No Type Date): US 98129812 A 19980806; US 9875990 P 19980225

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
WO 9943260	A1	E 33	A61B-006/00	

Designated States (National): AL AM AT AU AZ BA BB BG BR BY CA CH CN CU CZ DE DK EE ES FI GB GE GH GM HR HU ID IL IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MD MG MK MN MW MX NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT UA UG US UZ VN YU ZW

Designated States (Regional): AT BE CH CY DE DK EA ES FI FR GB GH GM GR IE IT KE LS LU MC MW NL OA PT SD SE SL SZ UG ZW

AU 9933120 A Based on patent WO 9943260

US 6076005 A A61B-005/055 Provisional application US 9875990

Method for gating therapeutic or diagnostic energy to tissue volume of medical patient during respiratory cycle

Abstract (Basic):

... flowing to and from the a patient's lungs are monitored to provide quasi-continuous **measurements** as a function of time, of flow rate, of pressure, patient **lung volume** and **carbon dioxide concentration**. The **measurements** are utilized to trigger the time period during which the energy is gated on, at the beginning of the selected portion of the **respiration** cycle, and the time period during which the energy is gated on, is terminated at the end of the selected portion of the **respiration** cycle.

... An INDEPENDENT CLAIM is included for a **system** for gating therapeutic or diagnostic energy to tissue volume of medical patient during **respiratory** cycle...

...For gating therapeutic or diagnostic energy to tissue volume of medical patient during **respiratory** cycle...

...assumed spatial position of the tissue volume arising from displacements induced by the patient's **respiration**.

Title Terms: **METHOD** ;

International Patent Class (Main): **A61B-005/055** ...

... **A61B-006/00**

30/3,K/88

DIALOG(R)File 350:Derwent WPIX

(c) 2004 Thomson Derwent. All rts. reserv.

012166487 \*\*Image available\*\*

WPI Acc No: 1998-583399/199849

XRAM Acc No: C98-174568

XRPX Acc No: N98-454477

**Apparatus for adding special gas to patient's breathing circuit -**

**delivered according to requirements into carrier gas via automatic valve**

Patent Assignee: INSTRUMENTARIUM CORP (INST-N)

Inventor: HEINONEN E

Number of Countries: 021 Number of Patents: 007

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
WO 9847555	A1	19981029	WO 98IB546	A	19980408	199849	B
EP 923397	A1	19990623	EP 98913973	A	19980408	199929	
			WO 98IB546	A	19980408		
US 5918596	A	19990706	US 97841466	A	19970422	199933	
CA 2255010	A1	20000604	CA 2255010	A	19981204	200043	N
JP 2000513618	W	20001017	JP 98545345	A	19980408	200056	
			WO 98IB546	A	19980408		
EP 923397	B1	20040804	EP 98913973	A	19980408	200451	
			WO 98IB546	A	19980408		
DE 69825403	E	20040909	DE 98625403	A	19980408	200459	
			EP 98913973	A	19980408		
			WO 98IB546	A	19980408		

Priority Applications (No Type Date): US 97841466 A 19970422; CA 2255010 A 19981204

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

WO 9847555 A1 E 27 A61M-016/12

Designated States (National): JP

Designated States (Regional): AT BE CH CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE

EP 923397 A1 E A61M-016/12 Based on patent WO 9847555

Designated States (Regional): DE FR GB IT SE

US 5918596 A A62B-007/00

CA 2255010 A1 E A61M-016/12

JP 2000513618 W 24 A61M-016/12 Based on patent WO 9847555

EP 923397 B1 E A61M-016/12 Based on patent WO 9847555

Designated States (Regional): DE FR GB IT SE

DE 69825403 E A61M-016/12 Based on patent EP 923397

Based on patent WO 9847555

**Apparatus for adding special gas to patient's breathing circuit...**

...Abstract (Basic): A special gas dose delivery unit is incorporated in **respiratory** equipment. It includes a flow conduit (19) for delivering the special gas from a source...

...parameters are set via a computer (27). A control unit (26) receives inputs from a **respiration** monitor and the computer (27). It provides a signal for operating the valve (21) to...

...USE - The special gas incorporated into the normal **breathing** mixture may be for diagnostic or therapeutic purposes. It may be nitric oxide for improvement of lung perfusion and thus patient O2 uptake raising the blood oxygen saturation, **sulphur** hexafluoride for **measuring** the lung functional residual volume, or **nitrous oxide** for

*INVENTOR*

*22 APRIL 1997*

measuring the lung capillary blood flow...

...gas or its reaction products with other gases. The interaction time between the special and **breathing gases** before **inhalation** is shortened. The equipment is also designed to minimise apparatus near the patient's mouth...

...Title Terms: **BREATH** ;

International Patent Class (Main): **A61M-016/12** ...

International Patent Class (Additional): **A61M-016/00**

30/3,K/93

DIALOG(R)File 350:Derwent WPIX

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011439917 \*\*Image available\*\*

WPI Acc No: 1997-417824/199739

XRPX Acc No: N97-347974

Method of determining functional residual capacity and other lung vol. of patient - involves comparing gas mixture or inspiration and expiration until difference falls below defined level for one cycle or until gas conc. changes can be predicted from variations in gas conc.

Patent Assignee: MPO GES MEDIZINTECHNISCHE PROD ORG MBH (MPOM-N); HECKER K (HECK-I); SCHINAGL R (SCHI-I); WAGNER T O F (WAGN-I)

Inventor: HECKER K; SCHINAGL R; WAGNER T O F; WAGNER T O

Number of Countries: 012 Number of Patents: 004

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
EP 791327	A2	19970827	EP 97102580	A	19970218	199739 B
DE 19606470	A1	19971120	DE 1006470	A	19960221	199801
US 5957128	A	19990928	US 97842179	A	19970423	199947 N
DE 19606470	C2	20010315	DE 1006470	A	19960221	200115

23 APRIL 1997

Priority Applications (No Type Date): DE 1006470 A 19960221; US 97842179 A 19970423

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

EP 791327 A2 G 4 A61B-005/091

Designated States (Regional): AT BE CH DE DK FR GB IT LI NL SE

DE 19606470 A1 4 A61B-005/083

US 5957128 A A61M-016/00

DE 19606470 C2 A61B-005/083

Method of determining functional residual capacity and other lung vol. of patient...

...involves comparing gas mixture or inspiration and expiration until difference falls below defined level for one cycle or until gas conc...

...Abstract (Basic): The method involves introducing helium or another inert gas and using an oscillation or other measurement. A gas mixture contg. helium is fed to the patient or subject in an open system via a respirator or other breathing aid and the conc. and quantity of the gas mixture and hence of the helium is measured by a measurement device (5) attached to the tube or breathing mask...

...The gas conc. or density is measured on expiration and the lung vol. determined by comparing the gas mixture or inspiration and expiration. The steps are repeated until the difference falls below a defined level for...

...ADVANTAGE - Can even be used during automatic breathing.

Title Terms: METHOD;

International Patent Class (Main): A61B-005/083 ...

... A61B-005/091 ...

... A61M-016/00

International Patent Class (Additional): A61M-016/00

30/3,K/94

DIALOG(R)File 350:Derwent WPIX

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011266980

WPI Acc No: 1997-244883/199722

XRPX Acc No: N97-201996

Method for artificially ventilating patient by determining class of lungs - selecting appropriate inspiratory waveform for particular patient lung class, and checking if patient lungs have equal individual time constants, unequal compliance, or equal compliance and unequal resistance

Patent Assignee: UNIV FLORIDA (UYFL )

Inventor: LAMPOTANG S; VAN OOSTROM J H M

Number of Countries: 071 Number of Patents: 003

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
WO 9714462	A1	19970424	WO 96US16430	A	19961015	199722 B
AU 9673686	A	19970507	AU 9673686	A	19961015	199735
US 6135105	A	20001024	US 95546301	A	19951020	200055

Priority Applications (No Type Date): US 95546301 A 19951020

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

WO 9714462 A1 E 94 A61M-016/00

Designated States (National): AL AM AT AU AZ BB BG BR BY CA CH CN CZ DE DK EE ES FI GB GE HU IL IS JP KE KG KP KR KZ LK LR LS LT LU LV MD MG MN MW MX NO NZ PL PT RO RU SD SE SG SI SK TJ TM TR TT UA UG UZ VN

Designated States (Regional): AT BE CH DE DK EA ES FI FR GB GR IE IT KE LS LU MC MW NL OA PT SD SE SZ UG

AU 9673686 A A61M-016/00 Based on patent WO 9714462

US 6135105 A A61M-016/00

Method for artificially ventilating patient by determining class of lungs...

...Abstract (Basic): To **determine** the class of lungs it is **determined** whether the patient has lungs with equal individual time constants, lungs of unequal compliance with...

...The patient is **ventilated** a first time, then **ventilated** a second longer time throughout a selected time period or number of **breaths** while maintaining tidal volume constant. The end tidal **carbon dioxide concentration** of the gas exhaled by the patient is sensed following each waveform, and compared...

...USE/ADVANTAGE - For delivery of **ventilatory** parameters including waveform, inspiratory time, inspiratory pause and tidal **volume**, among others, dependent on identified **lung** class of patient. Equalises distribution of **ventilation** in lungs with unequal resistance and or unequal compliance, and, minimises mean lung pressure over...

Title Terms: **METHOD** ;

International Patent Class (Main): **A61M-016/00**

30/3,K/97

DIALOG(R)File 350:Derwent WPIX

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010401802 \*\*Image available\*\*

WPI Acc No: 1995-303115/199540

XRPX Acc No: N95-230227

Method of determining anaerobic threshold in humans by measuring ventilation parameters - involves calculating value from formula comprising pulmonary capacity, its CO2 and O2 content parameters and plotting against time

Patent Assignee: STEGMANN H (STEG-I)

Inventor: STEGMANN H

Number of Countries: 062 Number of Patents: 011

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
DE 4406286	A1	19950831	DE 4406286	A	19940226	199540 B
WO 9522929	A1	19950831	WO 95EP711	A	19950227	199540
AU 9518122	A	19950911	AU 9518122	A	19950227	199550
EP 742693	A1	19961120	EP 95909788	A	19950227	199651
			WO 95EP711	A	19950227	
JP 9509345	W	19970922	JP 95522143	A	19950227	199748
			WO 95EP711	A	19950227	
EP 742693	B1	19971126	EP 95909788	A	19950227	199801
			WO 95EP711	A	19950227	
DE 59501042	G	19980108	DE 501042	A	19950227	199807
			EP 95909788	A	19950227	
			WO 95EP711	A	19950227	
AU 685596	B	19980122	AU 9518122	A	19950227	199811
ES 2113188	T3	19980416	EP 95909788	A	19950227	199822
NZ 281235	A	19980427	NZ 281235	A	19950227	199823
			WO 95EP711	A	19950227	
US 5782772	A	19980721	WO 95EP711	A	19950227	199836
			US 96696975	A	19961220	

Priority Applications (No Type Date): DE 4406286 A 19940226

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

DE 4406286 A1 4 A61B-005/083

WO 9522929 A1 G 20 A61B-005/22

Designated States (National): AM AT AU BB BG BR BY CA CH CN CZ DE DK EE ES FI GB GE HU JP KE KG KP KR KZ LK LR LT LU LV MD MG MN MW MX NL NO NZ PL PT RO RU SD SE SI SK TJ TT UA US UZ VN

Designated States (Regional): AT BE CH DE DK ES FR GB GR IE IT KE LU MC MW NL OA PT SD SE SZ UG

AU 9518122 A A61B-005/22 Based on patent WO 9522929

EP 742693 A1 G 4 A61B-005/22 Based on patent WO 9522929

Designated States (Regional): AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

JP 9509345 W 19 A61B-005/22 Based on patent WO 9522929

EP 742693 B1 G 9 A61B-005/22 Based on patent WO 9522929

Designated States (Regional): AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

DE 59501042 G A61B-005/22 Based on patent EP 742693

Based on patent WO 9522929

AU 685596 B A61B-005/22 Previous Publ. patent AU 9518122

Based on patent WO 9522929

ES 2113188 T3 A61B-005/22 Based on patent EP 742693

NZ 281235 A A61B-005/08 Based on patent WO 9522929

US 5782772 A A61B-005/08 Based on patent WO 9522929

Method of determining anaerobic threshold in humans by measuring

Compare  
ccA/M 4,  
10/650114

ventilation parameters...

...involves calculating value from formula comprising pulmonary capacity, its CO<sub>2</sub> and O<sub>2</sub> content parameters and plotting against time

...Abstract (Basic): The method depends on work done per time unit, the parameters being pulmonary capacity (V<sub>e</sub>), CO<sub>2</sub> content of pulmonary capacity (VCO<sub>2</sub>) and O<sub>2</sub> content of pulmonary capacity (VO<sub>2</sub>). The work load per time unit is increased in predetermined increments while simultaneously measuring the pulmonary capacity and its CO<sub>2</sub> and O<sub>2</sub> contents. According to the relation...

...the value of x is calculated on the basis of the measurements and plotted over time t. By joining the values of x during a specific exercise...

...The ventilation parameters may be determined when the work load is increased step by step or continuously...

...ADVANTAGE - Eliminates taking of blood samples and measuring of blood lactate, while giving great accuracy...

...Abstract (Equivalent): The method depends on work done per time unit, the parameters being pulmonary capacity (V<sub>e</sub>), CO<sub>2</sub> content of pulmonary capacity (VCO<sub>2</sub>) and O<sub>2</sub> content of pulmonary capacity (VO<sub>2</sub>). The work load per time unit is increased in predetermined increments while simultaneously measuring the pulmonary capacity and its CO<sub>2</sub> and O<sub>2</sub> contents. According to the relation...

...the value of x is calculated on the basis of the measurements and plotted over time t. By joining the values of x during a specific exercise...

...The ventilation parameters may be determined when the work load is increased step by step or continuously...

...ADVANTAGE - Eliminates taking of blood samples and measuring of blood lactate, while giving great accuracy...

Title Terms: METHOD ;

International Patent Class (Main): A61B-005/08 ...

... A61B-005/083 ...

... A61B-005/22

30/3,K/99

DIALOG(R)File 350:Derwent WPIX

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010279254 \*\*Image available\*\*

WPI Acc No: 1995-180511/199524

XPX Acc No: N95-141720

Measuring **functional residual capacity of lung - by timing rise and fall in concentration of supplied trace gas in expired air, and calculating volume of gas**

Patent Assignee: SIEMENS-ELEMA AB (SIEI ); SIEMENS ELEMA AB (SIEI );  
MAQUET CRITICAL CARE AB (STIL )

Inventor: BRAUER S; CASTOR R; LARSSON A; OLSSON S; SOEDRA S B; OLSSON S G

Number of Countries: 011 Number of Patents: 006

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
EP 653183	A1	19950517	EP 94114522	A	19940915	199524 B
SE 9303486	A	19950423	SE 933486	A	19931022	199528
US 5540233	A	19960730	US 94327990	A	19941024	199636
EP 653183	B1	19990113	EP 94114522	A	19940915	199907
DE 69415929	E	19990225	DE 94615929	A	19940915	199914
			EP 94114522	A	19940915	
JP 3553160	B2	20040811	JP 94257163	A	19941021	200453

Priority Applications (No Type Date): SE 933486 A 19931022

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing	Notes
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EP 653183	A1	E	8	A61B-005/08		
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Designated States (Regional): CH DE ES FR GB IT LI NL SE

SE 9303486	A			A61B-005/08		
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US 5540233	A		7	A61B-005/091		
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EP 653183	B1	E		A61B-005/08		
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Designated States (Regional): CH DE ES FR GB IT LI NL SE

DE 69415929	E			A61B-005/08	Based on patent EP 653183	
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JP 3553160	B2		11	A61M-016/00	Previous Publ. patent JP 7155379	
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Measuring **functional residual capacity of lung - ...**

**...by timing rise and fall in concentration of supplied trace gas in expired air, and calculating volume of gas**

...Abstract (Basic): The **method of measuring** function of lungs involves feeding a **breathing gas** of a given **concentration** into the lungs via a gas meter. A **concentration** of trace gas inspired and expired from the lungs is **measured**. Supply of trace gas is stopped when the two **concentrations** become identical. The **concentration** of trace gas expired is **measured** until it falls below a given threshold value...

...The flow of expired gas is **measured** for every **respiratory** cycle in this phase. The volume of gas expired in the second phase is **calculated** from the **concentration** and the **measured** flow of gas...

...USE/ADVANTAGE - For use during **anaesthesia**. Corrects for rebreathed gas by **measuring** fall time of trace gas. Improved accuracy...

...Abstract (Equivalent): A **method for determining** the functional residual **capacity** of **lungs**, comprising the steps of...

...supplying a predetermined **concentration** of a trace gas to a **breathing gas** and feeding said **breathing gas** with said predetermined **concentration** of said trace gas into the lungs through a gas meter during a wash-in...

Very, very  
GOOD  
!!!

see  
related  
documents  
beneath



... **measuring** the **concentration** of said trace gas in gas inspired by and expired from the lungs with said...

...stopping the supply of said trace gas when the **concentration** of said trace gas **measured** in the expired gas becomes identical to the **concentration measured** in the inspired gas...

... **measuring** the **concentration** of said trace gas in the expired gas in said washout phase with said gas meter until the **measured concentration** falls below a predetermined threshold value...

... **measuring** the flow of expired gas for every **respiratory** cycle in said washout phase; and...

...at an end of said washout phase, **calculating** the volume of said trace gas expired during the washout phase from the **measured concentration** of said trace gas in the expired gas and the **measured** flow of expired gas, and **calculating** the functional residual **capacity** of the **lungs** by dividing said **volume**, of said trace gas by said **concentration** of said trace gas

Title Terms: **MEASURE** ;

International Patent Class (Main): **A61B-005/08** ...

... **A61B-005/091** ...

... **A61M-016/00**



US005540233A

**United States Patent** [19]

Larsson et al.

[11] **Patent Number:** 5,540,233[45] **Date of Patent:** Jul. 30, 1996

[54] **METHOD FOR DETERMINING THE FUNCTIONAL RESIDUAL CAPACITY OF LUNGS AND A VENTILATOR FOR PRACTICING SAID METHOD**

[75] **Inventors:** Anders Larsson, Kaevlinge; Rolf Castor, Hægerstein; Stefan Brauer, Soedra Sandby; Sven G. Olsson, Arloev, all of Sweden

[73] **Assignee:** Siemens-Elerna AB, Solna, Sweden

[21] **Appl. No.:** 327,990

[22] **Filed:** Oct. 24, 1994

[30] **Foreign Application Priority Data**

Oct. 22, 1993 [SE] Sweden ..... 9303486

[51] **Int. Cl.<sup>6</sup>** ..... A61B 5/091

[52] **U.S. Cl.** ..... 128/725; 128/719

[58] **Field of Search** ..... 128/716, 719, 128/725

[56] **References Cited**

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3,527,206 9/1970 Jones .  
3,659,590 5/1972 Jones et al. .  
3,785,370 1/1974 Richards et al. .... 128/719  
4,418,701 12/1983 Luijpers .

4,941,476 7/1990 Fisher ..... 128/719

**FOREIGN PATENT DOCUMENTS**

2692772 12/1993 France ..... 128/725

2698260 5/1994 France ..... 128/725

952212 8/1982 U.S.S.R. .... 128/725

**OTHER PUBLICATIONS**

"Measurement of Functional Residual Capacity by Sulfur Hexafluoride Washout," Jonmarker, University of Lund, Sweden, 1985.

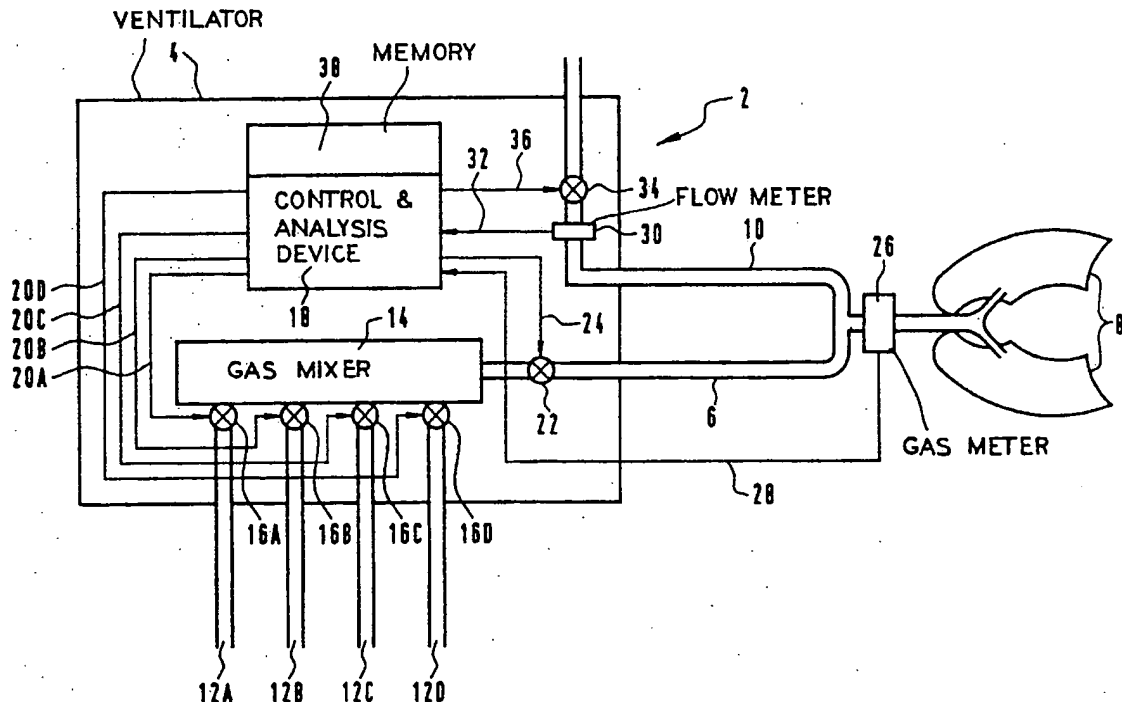
*Primary Examiner*—Lee S. Cohen

*Attorney, Agent, or Firm*—Hill, Steadman & Simpson

[57] **ABSTRACT**

In a method and a ventilator device for measuring the functional residual capacity, FRC, of lungs, a trace gas is mixed with a breathing gas in a gas mixer and the mixture is fed into the lungs via an inspiratory tube. When a predetermined concentration of trace gas is achieved in the lungs, the supply of trace gas is stopped, and a washout phase starts. During the washout phase, the concentration of trace gas in expired gas and the flow of expired gas are measured. The measurement values are sent to an analyzer which calculates the volume of trace gas in the lungs. Functional residual capacity can then be determined from the calculated volume of trace gas. The trace gas is preferably SF<sub>6</sub>.

7 Claims, 2 Drawing Sheets



equipped with a flow meter near the inspiratory tube 6 and FRC determined during the wash-in phase. Further, the ventilator device 2 in FIG. 1 can be used for spontaneously breathing patients as well as for supported and controlled mechanical ventilation of patients. In controlled mechanical ventilation of the patient, inspiratory flow through the inspiratory valve 22 can be controlled so exactly that this flow is always known (less than 0.1% deviation from set flow), and a flow meter is then unnecessary when determining FRC during wash-in. The ventilator device 2 can also be equipped with check valves in the inspiratory and expiratory tubes 6 and 10. As stated above, the apparatus 39 in FIG. 2 can even determine FRC during washout in the same manner as in the description of FIG. 1.

Although modifications and changes may be suggested by those skilled in the art, it is the intention of the inventors to embody within the patent warranted hereon all changes and modifications as reasonably and properly come within the scope of their contribution to the art.

We claim as our invention:

1. A method for determining the functional residual capacity of lungs, comprising the steps of:

supplying a predetermined concentration of a trace gas to a breathing gas and feeding said breathing gas with said predetermined concentration of said trace gas into the lungs through a gas meter during a wash-in phase;

measuring the concentration of said trace gas in gas inspired by and expired from the lungs with said gas meter;

stopping the supply of said trace gas when the concentration of said trace gas measured in the expired gas becomes identical to the concentration measured in the inspired gas;

starting a washout phase;

measuring the concentration of said trace gas in the expired gas in said washout phase with said gas meter until the measured concentration falls below a predetermined threshold value;

measuring the flow of expired gas for every respiratory cycle in said washout phase; and

at an end of said washout phase, calculating the volume of said trace gas expired during the washout phase from the measured concentration of said trace gas in the expired gas and the measured flow of expired gas, and calculating the functional residual capacity of the lungs by dividing said volume, of said trace gas by said concentration of said trace gas.

2. A method as claimed in claim 1, comprising the additional step of setting said gas meter to a null level for the concentration of said trace gas at said predetermined concentration.

3. A method as claimed in claim 1, comprising the additional steps of:

storing measurement values obtained during the washout phase in a memory;

measuring a signal drift of said gas meter; and

correcting the stored measurement values for the measured signal drift before calculating said volume.

4. A method as claimed in claim 1 wherein the step of measuring the concentration of said trace gas in the inspired gas comprises measuring the concentration of said trace gas in the inspired gas during said washout phase followed by measuring a volume of residual trace gas and thereby

identifying a re-breathed volume of trace gas, and correcting the calculated volume of trace gas by compensating for said re-breathed volume of trace gas.

5. A method for determining the functional residual capacity of lungs, comprising the steps of:

feeding a breathing gas comprising a predetermined concentration of a trace gas into the lungs through a gas meter during a wash-in phase;

measuring an inspired concentration of said trace gas in gas inspired by the lungs and an expired concentration of said trace gas expired from the lungs with said gas meter during said wash-in phase until the concentration of said trace gas in the inspired gas is the same as the concentration of said trace gas in the expired gas;

measuring an inspired flow of gas for each respiratory cycle in the wash-in phase;

measuring an expired flow of gas for each respiratory cycle in said wash-in phase;

calculating a volume of inspired trace gas in said wash-in phase from the measured inspired concentration of said trace gas and the measured inspired flow of gas and calculating a volume of expired trace gas from the measured expired concentration of said trace gas and the measured expired flow of gas; and

calculating a volume of said trace gas in the lungs by subtracting the volume of expired trace gas from the volume of inspired trace gas, and calculating the functional residual capacity of the lungs by dividing said volume of trace gas in the lungs by said expired concentration of said trace gas.

6. An apparatus for ventilating a patient comprising:

ventilator means for supplying breathing gas to and carrying expired gas away from the lungs of said patient;

a gas source, connected to said ventilator means, for supplying a trace gas mixed with said breathing gas to the lungs of said patient during a wash-in phase during the inspiratory phase of a plurality of respiratory cycles until the lungs contain a predetermined concentration of the trace gas;

gas meter means, through which the mixture of said breathing gas and said trace gas passes, for measuring the concentration of said trace gas during the wash-in phase and during a subsequent washout phase in the expiratory phase of said plurality of respiratory cycles until the concentration of said trace gas measured during the washout phase falls below a predetermined threshold value;

flow meter means for measuring expiratory flow during said washout phase; and

analyzer means supplied with said measured values for the trace gas concentration and expiratory flow during said washout phase, for determining the volume of trace gas leaving the lungs and, from said volume of trace gas leaving the lungs, determining the functional residual capacity of the lungs.

7. An apparatus as claimed in claim 6 wherein said analyzer means comprises a memory in which measurement values for the concentration of said trace gas and the flow of expired gas are stored during said washout phase.

\* \* \* \* \*

30/3,K/104

DIALOG(R)File 350:Derwent WPIX

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009776985 \*\*Image available\*\*

WPI Acc No: 1994-056837/199407

XRFX Acc No: N94-044720

Respiratory gas monitor for displaying e.g average whole body oxygen consumption - multiplies percentage change of oxygen and carbon dioxide content in mixing chamber compared to content in supply gas by flow rate in supply line, to determine consumption and production rates

Patent Assignee: UNIV TEMPLE (UTEM )

Inventor: LYNCH T J

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
US 5285794	A	19940215	US 92990203	A	19921214	199407 B

Priority Applications (No Type Date): US 92990203 A 19921214

Patent Details:

Patent No Kind Lan Pg Main IPC Filing Notes

US 5285794 A 8 A61B-005/083

Respiratory gas monitor for displaying e.g average whole body oxygen consumption...

...multiplies percentage change of oxygen and carbon dioxide content in mixing chamber compared to content in supply gas by flow rate in supply line, to determine consumption and production rates

...Abstract (Basic): The appts for monitoring the respiratory gas of a patient includes an adjustable volume gas mixing chamber which allows for the differences in lung capacity of patients from neonate to adult. A constant flow of a therapeutic gas mixture is measured by a flow meter in a supply line leading to a face mask breathing device. The mask is by-pass connected to the supply line such that the patient ...

...Both by-pass and expired gas mix and enter the adjustable -volume chamber, which contains an internal fan and sensors for detecting percentage content of oxygen and carbon dioxide . The chamber is adjusted to a volume where the sensor readings become stable rather than pulsatile. The change in percentages of oxygen and carbon dioxide content in the chamber, as compared to the content in the supply gas, is then entirely due to total-body consumption and production. Whole body rates can be determined by multiplying the percentage change by the flow rate in the supply line...

...USE/ADVANTAGE - Monitoring and displaying average whole-body oxygen consumption, and/or carbon dioxide production, and/or Respiratory Exchange Ratio. Intensive care units with respirators for e.g in care of premature infants suffering from respiratory distress syndrome. Reduces amount of hardware required and does not require directional valves to isolate expired respiratory gases...

Title Terms: RESPIRATION ;

International Patent Class (Main): A61B-005/083

14 DEC  
1992

30/3,K/127

DIALOG(R)File 350:Derwent WPIX

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004353673

WPI Acc No: 1985-180551/198530

XRAM Acc No: C85-078652

XRPX Acc No: N85-135592

Determining closing volume of lungs - using helium and ultrasonic wave transmitting and receiving element

Patent Assignee: NIPPON KODEN KOGYO (NIKO-N)

Number of Countries: 001 Number of Patents: 002

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
JP 60108032	A	19850613	JP 83216812	A	19831117	198530 B
JP 89058981	B	19891214				199003

Priority Applications (No Type Date): JP 83216812 A 19831117

Patent Details:

Patent No	Kind	Lan Pg	Main IPC	Filing Notes
JP 60108032	A	4		

Determining closing volume of lungs - ...

...using helium and ultrasonic wave transmitting and receiving element

...Abstract (Basic): Method of determining closing volume is claimed, in which helium is forcedly respired in the initial stage of respiration, the amt. of expiration and the concn. of He in the expired gas are determined on expiration, and closing volume is determined from the corelationship between the two values determined. An ultrasonic wave transmitting element and an ultrasonic wave receiving element are arranged at a distance along the passage of the respiration and the expiration. The process comprises calculating expiration rate V and speed of sound C from the ultrasonic wave propagation rates in the respiration direction and the reverse direction between the two elements, and using expiration rate V as an equiv. for expiration flow and speed of sound C as an equivalent for He concn. respectively...

...ADVANTAGE - Expiration flow and He concn. can be determined by a single ultrasonic wave type sensor, consequently the device for the determination can be made small size and low cost and the response characteristics in the initiation

Title Terms: DETERMINE ;

International Patent Class (Additional): A61B-005/08 ...

30/3,K/129

DIALOG(R)File 350:Derwent WPIX

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004066714

WPI Acc No: 1984-212255/198434

XPX Acc No: N84-158909

**Alveolar lung ventilation measurement - by using respiration volume in which is changed**

Patent Assignee: YALTA PHYSIOTHERAPY (YALT-R)

Inventor: BOKSHA V G; KOVALCHUK S I; MANDEL P I

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
SU 1063386	A	19831230	SU 2800983	A	19790719	198434 B

Priority Applications (No Type Date): SU 2800983 A 19790719

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
SU 1063386	A		2		

**Alveolar lung ventilation measurement - ...**

**...by using respiration volume in which is changed**

**...Abstract (Basic): The method of measuring the alveolar ventilation of the lungs involves measuring the functional residual volume of the lungs and the concentration of control gas in the mixture exhaled during the process of respiration, after which the degree of ventilation is calculated.**

...

**...To increase the accuracy of measuring alveolar lung ventilation, the volume of respiration during the process of which half the functional resilient volume is changed is measured.**

...

**...For the investigation a spiograph equipped with a respiration volume recorder and a sensor of the concentration of nitrogen in exhaled gas is used. The spiograph should also be able to switch from atmosphere...**

**...atmosphere air, then the machine is switched to oxygen supply, and all the time the concentration of nitrogen in exhaled gas is measured, until it stops reducing. Bul.48/30.12.83**

**...Title Terms: VENTILATION ;**

**International Patent Class (Additional): A61B-005/00**

30/3,K/131

DIALOG(R)File 350:Derwent WPIX

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003739395

WPI Acc No: 1983-735592/198333

XRAM Acc No: C83-076931

XRPX Acc No: N83-141829

Ascertaining residual vol. in lung - using test gas mixt. given in closed circuit with an automatic analyser

Patent Assignee: ADW DDR ZENT ISOTOP (DEAK )

Inventor: FAUST H; REINHARDT R; SCHAUER J

Number of Countries: 001 Number of Patents: 001

Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week
DD 200353	A	19830420				198333 B

Priority Applications (No Type Date): DD 233823 A 19811002

Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
DD 200353	A		9		

Ascertaining residual vol. in lung...

...Abstract (Basic): Method for ascertaining the residual volume in a lung uses a test gas in a spirometer with oxygen as a stabiliser that is inhaled...

...the patient after maximum expiration. The test gas is composed of 20% oxygen and 80% nitrogen with the stable isotope Nitrogen 15 between 8-20 Atom% 15N. The patient breathes the gas on a closed circuit and an automatic dosing system for analysing the spectral emission of nitrogen 15 is introduced...

...The test is conducted by the analyser until a constant nitrogen 15 frequency is recorded which indicates a complete mixing between the isotope nitrogen and the ordinary nitrogen. From the beginning and end frequencies of the spirometer nitrogen and the known spirometer volume the unknown nitrogen of the lung is calculated which simply gives the residual volume...

...The progress of the mixing process with respect to time during breathing is plotted as a curve. As the progress of the mixing process (shape of the curve) and the time for complete mixing are different, conclusions about ventilation comparisons can be drawn

Title Terms: ASCERTAIN ;

International Patent Class (Additional): A61B-005/08

Set	Items	Description
S1	2598905	RESPIRAT? OR INSUFFLAT? OR VENTILAT? OR BREATHE? OR BREATH- ING OR INHALAT? OR PCV OR VCV OR PEEP OR POSITIVE()END()EXPIR- ?()PRESSUR?
S2	103788	(LUNG? OR PULMON?) (5N) (CAPACIT? OR VOLUM?)
S3	21620	(GAS OR GASES OR GASSES) (3N) (FLOW? OR EXCHANG? OR BACK(2W)- FORTH) (3N) (EFFICIEN? OR EFFICAC? OR EFFECTIVENESS? OR HOMOGEN? OR INHOMOGEN? OR EQUILIBRIUM? OR PERFORM? OR FUNCTION?)
S4	1911609	BREATH?() (GAS OR GASES OR GASSES) OR ANESTH? OR ANAESTH? OR NITROUS()OXID? OR LAUGHING()GAS OR N2O OR N()SUB()2()O OR CA- RBON()DIOXID? OR CO2 OR CO()SUB()2 OR CARBONIC()ANHYDRID?
S5	172058	RN=(124-38-9 OR 10024-97-2)
S6	12951190	CONCENTRATION? OR STRENGTH? OR PERCENT? OR POTENC? OR DILU- T?(2N) (RATIO? OR FACTOR? OR MIXTUR? OR ADMIX?) OR AMOUNT? OR - CONTENT
S7	32191616	MEASUR? OR MENSUR? OR DETERMIN? OR CALCULAT? OR QUANTIF? OR ESTIMAT? OR GAUG? OR EVALUAT? OR ASCERTAIN? OR COMPUTING? OR ASSESS?
S8	396820	BREATH OR BREATHS OR INSPIRATION? OR INHALATION? OR ENDBRE- ATH? OR TIDALBREATH?
S9	4894573	ELIMINAT? OR RID OR RIDS OR RIDDING OR REMOV? OR EXPURG? OR PURG? OR SUBTRACT? OR ADJUST? OR EXCLUD? OR EXCLUS?
S10	1210958	INERT(2N) (GAS OR GASES OR GASSES) OR ANESTH? OR ANAESTH? OR FLUOROPROPAN? OR FLUORO()PROPAN? OR HFC()281 OR HFC281 OR HY- DROFLUOROCARBON()281
S11	2720120	NITROGEN OR N()SUB()2 OR N2 OR HELIUM OR HE OR (SULFUR OR - SULPHUR) () (FLUORID? OR HEXAFLUORID?) OR ELEGAS OR SF6 OR SF()- SUB()6
S12	186152	RN=(7440-59-7 OR 2551-62-4 OR 7727-37-9)
S13	2191181	TRACER? OR MARKER? OR INDICATOR?
S14	17370480	METHOD OR METHODS
S15	71283	S1 AND S2
S16	17443	S15 AND S14
S17	71283	S15:S16
S18	1714	S17 AND S3
S19	71283	S17:S18
S20	10044	S19 AND S4:S5 AND S10:S12
S21	2432	S20 AND S14
S22	341	S21 AND S7 AND S9
S23	131	S22 AND (S6 OR S13)
S24	2432	S21:S22
S25	105	S24 AND S3
S26	476	S24 AND S7(5N)S10:S12
S27	943	S21 AND (S14 OR SYSTEM? OR PROCESS?? OR PROCEI IQUE?) (5N) (S7 OR S9)
S28	301	S26 AND S27
S29	45	S21 AND S2(10N)S3
S30	57	S28 AND S22
S31	258	S23 OR S25 OR S29 OR S30
S32	245	S31 AND PY<2004
S33	104	S32 AND S8
S34	245	S32:S33
S35	174	RD (unique items)

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File 2:INSPEC 1969-2004/Dec W1  
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File 583:Gale Group Globalbase(TM) 1986-2002/Dec 13  
(c) 2002 The Gale Group  
?

35/3,K/15 (Item 13 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
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0011616349 BIOSIS NO.: 199800410596

**Pathophysiology of changes in absolute lung volumes**

AUTHOR: Bancalari E (Reprint); Clausen J

AUTHOR ADDRESS: PO Box 016960, Univ. Miami Sch. Med., Miami, FL 33101, USA  
\*\*USA

JOURNAL: European Respiratory Journal 12 (1): p248-258 July, 1998 1998

MEDIUM: print

ISSN: 0903-1936

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: English

**Pathophysiology of changes in absolute lung volumes**  
1998

ABSTRACT: Changes in absolute lung volumes are common in lung disease and result in significant impacts on gas exchange, respiratory muscle function, the sensation of dyspnoea, and limitations to maximal exercise. Though our knowledge regarding the magnitude and determinants of changes in lung volumes in health and -disease has increased in the past 20 years, a number of important questions remain unanswered. Consideration of the limitations of specific methods for measuring lung Volumes is essential when analyzing published studies regarding absolute lung volumes in infants, children and adults. Though functional residual capacity is most commonly measured in children...

...directed to making these measurements under clinically more relevant conditions (e.g. during exercise, sleep, anesthesia, or mechanical ventilation). The relationships between dynamic changes in functional residual capacity, flow limitation during tidal breaths, sensation of dyspnoea and exercise limitation are important to understand, and are the focus of...

...evaluating the efficacy of and optimal patient selection for new modes of therapy, such as lung volume reduction surgery.

DESCRIPTORS:

MAJOR CONCEPTS: Respiratory System...

... Respiration

...DISEASES: respiratory system disease, acute, pathophysiology, chronic

MISCELLANEOUS TERMS: ...absolute lung volume, functional residual capacity, residual volume, total lung capacity

35/3,K/26 (Item 24 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
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0009030528 BIOSIS NO.: 199497051813

**Intrapulmonary gas mixing and pulmonary gas exchange in artificially ventilated dogs**

AUTHOR: Schrikker A C M; Wesenhagen H; Luijendijk S C M (Reprint)

AUTHOR ADDRESS: Dep. Pulmonology, Univ. Hosp. Maastricht, P.O. Box 5800,

NL-6202 AZ Maastricht, Netherlands\*\*Netherlands

JOURNAL: Pfluegers Archiv European Journal of Physiology 425 (1-2): p16-21  
1993 1993

ISSN: 0031-6768

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: English

**Intrapulmonary gas mixing and pulmonary gas exchange in artificially ventilated dogs**  
1993

...ABSTRACT: effect of incomplete gas mixing between tidal air and residual gas on pulmonary gas exchange, **anaesthetized** dogs were **ventilated** artificially with **breathing** patterns with different durations of the post-inspiratory apnoea ( $t-a = 0, 0.5, 1.0$  and  $2.0$  s), where tidal volume, **breathing** frequency, inspiratory and expiratory flow patterns were kept constant. We **determined** the alveolar **ventilations** ( $\text{ovrhdot } V-A$ ) of **He** and SF-6 from the product of end-expiratory **lung volume** ( $V-L,E'$ ) and specific **ventilation**  $V-L,E'$  was **determined** by the dilution technique and the specific **ventilations** of the two gases were obtained from their multiple- **breath** washout. Further, **tracer amounts** of acetone, ether and enflurane were infused continuously into a peripheral vein and a bolus...

...a gas mixture of krypton, Freon12 and SF, was introduced into the peritoneal cavity. We **determined** the Excretion (E) and Retention (R) of these six gases according to the multiple- **inert - gas - elimination** technique (MIGET).  $\text{ovrhdot } V-A$  increased with increasing  $t-a$ , where  $\text{ovrhdot } V-A$ , **He** was about 14% larger than for both gases, however, the increase in  $\text{ovrhdot } V-A$ ...

...curve shifted to larger E values with increasing  $t-a$ . E for the most soluble **tracer** gas (acetone) increased by 11, 21 and 25% for  $t-a = 0.5, 1.0$  and  $2.0$  s respectively,  $\text{ovrhdot } V-A$ , **determined** with MIGET from the **ventilation** /perfusion distribution, increased by almost the same **percentages**. These results are interpreted to indicate that pulmonary gas exchange is substantially impaired by incomplete...

DESCRIPTORS:

...MAJOR CONCEPTS: **Methods** and Techniques...

... **Respiratory** System...

... **Respiration**

MISCELLANEOUS TERMS: ...MULTIPLE- **INERT - GAS - ELIMINATION** TECHNIQUE

...

... **VENTILATION** /PERFUSION INEQUALITY

35/3,K/31 (Item 29 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
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0006615523 BIOSIS NO.: 198987063414

THE LUNG VOLUME AT WHICH SHUNTING OCCURS WITH INHALATION ANESTHESIA  
AUTHOR: DUECK R (Reprint); PRUTOW R J; DAVIES N J H; CLAUSEN J L; DAVIDSON  
T M

AUTHOR ADDRESS: ANESTHESIOLOGY SERVICE, V-125, 3350 LA JOLLA VILLAGE DRIVE,  
SAN DIEGO, CALIFORNIA 92161, USA\*\*USA

JOURNAL: Anesthesiology (Hagerstown) 69 (6): p854-861 1988

ISSN: 0003-3022

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: ENGLISH

THE LUNG VOLUME AT WHICH SHUNTING OCCURS WITH INHALATION ANESTHESIA  
1988

ABSTRACT: The relationship between functional residual capacity (FRC) and shunt development with halothane **anesthesia** in 18 nonobese surgical patients (age, 21-34 yr) was studied. FRC was **measured** by **helium** dilution, and intrapulmonary shunt was distinguished from **ventilation**-perfusion inequality by multiple **tracer inert gas elimination** analysis. Awake supine FRC was 34.6  $\pm$  6.6% (mean  $\pm$  SD) of total **lung capacity** (TLC), and closing **capacity** (CC) was 29.8  $\pm$  5.3% of TLC. **Anesthesia**, muscle paralysis, tracheal intubation, and mechanical **ventilation** produced an average 14.6  $\pm$  13.3% FRC reduction to an average **anesthesia** FRC 29.8% of TLC (P = 0.002). Shunt increased from 1.2%  $\pm$  1.5% awake to 8.6  $\pm$  8.3% during **anesthesia** (P = 0.005). A nonlinear relationship was found between shunt and FRC/TCL so that **anesthetized** subjects with an FRC less than awake CC had an average 11.4  $\pm$  8.3...

...regression of shunt on BMI (body mass index = weight/height<sup>2</sup>) showed a significant increase during **anesthesia** (P = 0.005), and smokers had a significantly higher slope compared to nonsmokers (P = 0.001). These findings suggest a gravity-dependent mechanism for intrapulmonary shunting during **anesthesia**. Therefore, shunting was due to dependent regional **lung volume** reduction associated with an FRC decrease to less than closing capacity. The enhanced intrapulmonary shunting...

...REGISTRY NUMBERS: 10024-97-2 ...

... NITROUS OXIDE

DESCRIPTORS: HUMAN HALOTHANE NITROUS OXIDE GENERAL ANESTHETIC -DRUG  
OBESITY SMOKING FUNCTIONAL RESIDUAL CAPACITY TOTAL LUNG CAPACITY  
CLOSING CAPACITY

DESCRIPTORS:

MAJOR CONCEPTS: **Methods** and Techniques...

... Respiratory System...

... Respiration ;

CHEMICALS & BIOCHEMICALS: ... NITROUS OXIDE

35/3,K/56 (Item 19 from file: 34)  
DIALOG(R)File 34:SciSearch(R) Cited Ref Sci  
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03266495 Genuine Article#: NR916 No. References: 23

Title: **A MODIFIED PHOTOACOUSTIC AND MAGNETOACOUSTIC MULTIGAS ANALYZER  
APPLIED IN GAS-EXCHANGE MEASUREMENTS**

Author(s): CLEMENSEN P; CHRISTENSEN P; NORSK P; GRONLUND J

Corporate Source: INNOVISION AS, DEPT RES & DEV, LINDVEDVEJ 75/DK-5260 ODENSE  
S//DENMARK//; ODENSE UNIV HOSP, DEPT ANAESTHESIA & INTENS CARE/DK-5000  
ODENSE//DENMARK//; RIGSHOSP, DANISH AEROSP MED CTR RES/DK-2200  
COPENHAGEN//DENMARK/

Journal: JOURNAL OF APPLIED PHYSIOLOGY, 1994, V76, N6 (JUN), P2832-2839

ISSN: 8750-7587

Language: ENGLISH Document Type: ARTICLE (Abstract Available)

, 1994

...Abstract: feasibility of replacing a conventional mass spectrometer (MS) with a specially modified multicomponent (O-2, CO<sub>2</sub>, Freon 22, and SF<sub>6</sub>) acoustic infrared and paramagnetic (IR/PM) gas analyzer in inert gas -rebreathing and metabolic gas exchange measurements has been investigated. Rebreathing variables were determined simultaneously with...

...0.006 +/- 0.030 l/min [O-2 consumption (VO<sub>2</sub>)], and -33 +/- 108 ml [combined lung tissue and capillary blood volume (V<sub>ti,c</sub>)]. The coefficients of variation on repeated estimates were 5.8% (FRC), 5.4...

...were -0.006 +/- 0.020 l/min (VO<sub>2</sub>) and 0.020 +/- 0.021 l/min (CO<sub>2</sub> production). Breath -by- breath estimates of VO<sub>2</sub> and CO<sub>2</sub> production with the IR/PM analyzer were, on average, 2.4 and 4.4% higher...

...Identifiers--BY- BREATH MEASUREMENT; CARDIAC-OUTPUT; TISSUE VOLUME ; LUNG -TISSUE; BLOOD-FLOW; DELAY; VCO<sub>2</sub>; VO<sub>2</sub>

Research Fronts: 92-0735 001 ( GAS - EXCHANGE MONITORING FUNCTION ; AUTOMATED BLOOD PRESSURES; INDIRECT CALORIMETRY; STATISTICAL- METHODS FOR ASSESSING AGREEMENT)

92-2119 001 (EXERCISE TRAINING; RESPIRATORY MUSCLE FAILURE; ANAEROBIC THRESHOLD; CHRONIC OBSTRUCTIVE PULMONARY-DISEASE)

92-2427 001 (CARDIOVASCULAR REACTIVITY; IMPEDANCE CARDIOGRAPHY...

35/3,K/61 (Item 24 from file: 34)  
DIALOG(R)File 34:SciSearch(R) Cited Ref Sci  
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01062742 Genuine Article#: FR558 No. References: 19  
**Title: COMPARISON OF ESTIMATES OF CARDIAC-OUTPUT BY INDICATOR DILUTION  
AND FREON 22 UPTAKE DURING GAS MIXING IN DOGS**  
Author(s): JONES HA; LAKSHMINARAYAN S; BECKET JM; HUGHES JMB  
Corporate Source: HAMMERSMITH HOSP, ROYAL POSTGRAD MED SCH/LONDON W12  
ONN//ENGLAND/  
Journal: CARDIOVASCULAR RESEARCH, 1991, V25, N6, P523-528  
Language: ENGLISH Document Type: ARTICLE (Abstract Available)

**Title: COMPARISON OF ESTIMATES OF CARDIAC-OUTPUT BY INDICATOR DILUTION  
AND FREON 22 UPTAKE DURING GAS MIXING IN DOGS**  
, 1991

Abstract: Study objective - The aim was to **measure** cardiac output while rebreathing tidal volumes, by correction of soluble gas uptake for gaseous mixing.

Design - Simultaneous **measurements** of cardiac output by indocyanin green and freon 22 uptake during rebreathing were made. Mixing for a hypothetical gas of identical gaseous diffusivity to freon 22 was **calculated** by interpolation between **concentrations** of two insoluble gases, **helium** and **sulphur hexafluoride**. Mixing efficiency was **estimated** by the number of **breaths** for **helium** to become 99% equilibrated with lung gas (n99- He ).

Experimental material - Five **anaesthetised** dogs rebreathed at intervals with 300 ml of test gas.

**Measurements** and main results - 63 comparisons of cardiac output using indocyanin green and freon 22 uptake (over **breaths** 7-13 using the mean mixed volume of distribution), gave a mean (95% confidence interval) underestimation of 0.345 (0.093-0.597) litre.min-1 (14%). **Exclusion** of 12 points in which n99- He was greater than 15 resulted in a mean underestimation of 0.052 (-0.163-0...

...blood flow by a mean of 1.31 litre.min-1 (overestimation = 2.7 over **breaths** 5-11). Use of the equilibrium volume of distribution resulted in an overestimation of blood flow relative to green dye of 1.2 litre.min-1 ( **breaths** 5-11) and 0.76 litre.min-1 ( **breaths** 7-13).

Conclusions - **Estimates** of cardiac output by soluble gas uptake are optimal when correction is made for mixing...

...of identical diffusivity. The mean mixed gas volume gives the best correlation with the reference **method**, implying a selective distribution of blood flow to the better **ventilated** areas.

...Identifiers-- **PULMONARY TISSUE VOLUME**; **CAPILLARY BLOOD-FLOW**; **INERT - GASES**; **LUNG**

Research Fronts: 89-3646 002 (EXTENDED SOLUBLE GAS-EXCHANGE MODEL FOR **ESTIMATING** PULMONARY PERFUSION; CARDIAC-OUTPUT DURING EXERCISE)  
89-0714 001 (FORCED EXPIRATORY VOLUME; MULTIGATED PULSED DOPPLER **SYSTEM** IN CHILDREN; **EVALUATION** OF A HAND-HELD SPIROMETER)

35/3,K/66 (Item 3 from file: 73)  
DIALOG(R)File 73:EMBASE  
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11901223 EMBASE No: 2003013511

**Pulmonary blood flow (cardiac output) and the effective lung volume determined from a short breath hold using the differential fick method**  
Gedeon A.; Krill P.; Osterlund B.  
A. Gedeon, Floragatan 15, 114 31 Stockholm Sweden  
AUTHOR EMAIL: gedeon@chello.se  
Journal of Clinical Monitoring and Computing ( J. CLIN. MONIT. COMPUT. )  
(Netherlands) 2002, 17/5 (313-321)  
CODEN: JCMCF ISSN: 1387-1307  
DOCUMENT TYPE: Journal ; Article  
LANGUAGE: ENGLISH SUMMARY LANGUAGE: ENGLISH  
NUMBER OF REFERENCES: 28

**Pulmonary blood flow (cardiac output) and the effective lung volume determined from a short breath hold using the differential fick method**

...This work attempts to show how pulmonary blood flow (Qp), cardiac output (COSUBFick) and the lung volume of effective gas exchange (ELV) can be determined from breath-by-breath measurements of the tidal exhaled COSUB2 elimination V (litre/min) and the end tidal COSUB2 concentration P (%) using the differential Fick method. The measurements are made during steady state ventilation and when the COSUB2 balance in the lungs changes subsequent to a perturbation of the gas exchange conditions. **Methods**. A short breath hold is used to implement such a perturbation. V and P were measured in patients on mechanical ventilation. When the end tidal COSUB2 values were stable, the end inspiratory pause of a single breath was prolonged 3 seconds as compared to the normal ventilation pattern. From the changes induced in P and V, Qp, COSUBFick and ELV are obtained. Results: Cardiac output values were measured in 18 patients after CABG. COSUBFick was found to be in good agreement with the...

...Mean = -0.17 litre/minute and SD = 0.62 litre/minute). Conclusions. With a single breath perturbation, the differential Fick method can yield cardiopulmonary information using 2-3 breaths only and with a minimum of interference with the patient. Complete data analysis results in multiple determinations of the Qp and ELV values which improve the attainable precision. Our investigation points to the possibility to determine Qp, COSUBFick and ELV also during spontaneous breathing, by using the natural tidal variations of V and P.

DEVICE BRAND NAME/MANUFACTURER NAME: Siemens Elema AB Servo Ventilator 300/Siemens Elema; Siemens Sirecust 1280/Siemens/Germany; Novamatrix Capnograph/Novamatrix  
DRUG DESCRIPTORS:

carbon dioxide

MEDICAL DESCRIPTORS:

\* lung blood flow; \*heart output; \* lung volume ; \* breath holding  
...clinical article; controlled study; male; female; adult; aged; lung gas exchange; expired air; end tidal carbon dioxide tension; steady state; lung function test; artificial ventilation ; comparative study; breathing pattern; thermodilution; data analysis; cardiopulmonary hemodynamics; coronary artery disease--surgery--su; coronary artery bypass graft; ventilator ; reference value; measurement ; monitoring; capnography; article; priority journal  
CAS REGISTRY NO.: 124-38-9 ...

...58561-67-4 ( carbon dioxide )

SECTION HEADINGS:

- 015 Chest Diseases, Thoracic Surgery and Tuberculosis
  - 018 Cardiovascular Diseases and Cardiovascular Surgery
  - 024 **Anesthesiology**
  - 027 Biophysics, Bioengineering and Medical Instrumentation
- 2002



35/3,K/109 (Item 46 from file: 73)  
DIALOG(R)File 73:EMBASE  
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02900851 EMBASE No: 1985144810

Pulmonary **diffusing** capacity for carbon monoxide by rebreathing in  
**mechanically** ventilated **patients**

Burchardi H.; Stokke T.

Zentrum Anaesthesiologie, University of Gottingen, D-3400 Gottingen  
Germany

Clinical Respiratory Physiology ( CLIN. RESPIR. PHYSIOL. ) (United  
Kingdom) 1985, 21/3 (263-273)

CODEN: CRPHD

DOCUMENT TYPE: Journal

LANGUAGE: ENGLISH SUMMARY LANGUAGE: FRENCH

Pulmonary **diffusing** capacity for carbon monoxide by rebreathing in  
**mechanically** ventilated **patients**

Determination of **pulmonary** **diffusing** **capacity** is a routine **method**  
in **pulmonary** function laboratories for spontaneous **breathing** patients.  
However, it is not used in intensive care medicine for controlled  
**ventilated** patients with severe **respiratory** failure. We describe a  
rebreathing **method** for determination of **pulmonary** **diffusing** **capacity**  
for carbon monoxide (DCO) during mechanical **ventilation** based on an  
improved mathematical approach by Piiper and coworkers. The theoretical  
two-compartment model...

...lung, it is advantageously qualified for measurements in intensive care  
patients. By adding an insoluble **inert** **gas** (for instance argon),  
functional residual capacity (FRC) can be determined at the same time. The  
**method** is well reproducible (+/- 3.8% for DCO and +/- 2.1% for FRC in  
duplicate determinations). During mechanical **ventilation**, the borderline  
towards pathological values determined by this **method** proved to be about  
10 ml-minsup -sup 1-mmHg<sup>sup</sup> -sup 1. First experimental and...

...results are presented which demonstrate DCO to be a qualified parameter  
for evaluating the pulmonary **gas** **exchange** **function**, indicating a  
progression of **respiratory** failure.

MEDICAL DESCRIPTORS:

\*adult **respiratory** distress syndrome; \*artificial **ventilation**; \*lung  
diffusion **capacity**; \*rebreathing  
functional residual capacity; priority journal; diagnosis; therapy; human  
experiment; animal experiment; human; nonhuman; swine; **respiratory** system

SECTION HEADINGS:

015 Chest Diseases, Thoracic Surgery and Tuberculosis

024 **Anesthesiology**

1985

35/3,K/110 (Item 47 from file: 73)  
DIALOG(R)File 73:EMBASE  
(c) 2004 Elsevier Science B.V. All rts. reserv.

02839491 EMBASE No: 1985183450

Measurement of functional residual capacity by sulfur hexafluoride washout

Jonmarker C.; Jansson L.; Jonson B.; et al.

Department of Anesthesiology, University Hospital, S-221 85 Lund Sweden

Anesthesiology ( ANESTHESIOLOGY ) (United States) 1985, 63/1 (89-95)

CODEN: ANESA

DOCUMENT TYPE: Journal

LANGUAGE: ENGLISH

Measurement of functional residual capacity by sulfur hexafluoride washout

Measurement of functional residual capacity (FRC) by the open-circuit multiple breath tracer gas washout technique is an established method. A system based upon washout of sulfur hexafluoride (SF<sub>6</sub>) during mechanical ventilation is described. The central unit in the system is a sensitive and rapid-response infrared SF<sub>6</sub> analyzer. SF<sub>6</sub> is washed in until the alveolar concentration of SF<sub>6</sub> is 0.5%, a concentration so low that the supply of other gases is hardly influenced. During washout, the flow of SF<sub>6</sub> from the lungs is calculated by a computer every 10 ms from signals representing expiratory flow and SF<sub>6</sub> concentrations. The total volume of SF<sub>6</sub>, washed out, is calculated by integration of SF<sub>6</sub> flow. Since the alveolar concentration at the end of washin is known, the lung volume may be obtained. The measurement procedure is highly automated and the result is presented by the computer immediately after washout. Accurate...

...reproducible results in model lung tests were obtained during air and N<sub>2</sub>O/O<sub>2</sub> ventilation. Comparison with body plethysmography (FRC(BOX)) in eight sitting healthy subjects gave the following: FRC(SF<sub>6</sub>) = 7 ml + 0.98 x FRC(BOX), r = 0.99. Comparison with nitrogen washout (FRC(N<sub>2</sub>)) in five postoperative patients gave the following: FRC(SF<sub>6</sub>) = 59...

...x FRC(N<sub>2</sub>), r = 0.97. FRC(SF<sub>6</sub>) during N<sub>2</sub>O/O<sub>2</sub> ventilation was the same as during air/O<sub>2</sub> ventilation in a group of paralyzed patients. The measurement system has not been tested in patients with obstructive lung disease.

DRUG DESCRIPTORS:

\* nitrous oxide ; \* sulfur hexafluoride

MEDICAL DESCRIPTORS:

\*drug efficacy; \*drug elimination ; \*functional residual capacity ; \*lung function test

measurement ; respiratory system ; priority journal; human; normal human; diagnosis; human experiment

CAS REGISTRY NO.: 10024-97-2 ( nitrous oxide ); 2551 -62-4 ( sulfur hexafluoride )

SECTION HEADINGS:

037 Drug Literature Index

024 Anesthesiology

002 Physiology

027 Biophysics, Bioengineering and Medical Instrumentation

1985

35/3,K/111 (Item 48 from file: 73)  
DIALOG(R)File 73:EMBASE  
(c) 2004 Elsevier Science B.V. All rts. reserv.

02839490 EMBASE No: 1985183449

**An analyzer for in-line measurement of expiratory sulfur hexafluoride concentration**

Jonmarker C.; Castor R.; Drefeldt B.; Werner O.  
Department of Anesthesiology, University Hospital, S-221 85 Lund Sweden  
Anesthesiology ( ANESTHESIOLOGY ) (United States) 1985, 63/1 (84-88)  
CODEN: ANESA  
DOCUMENT TYPE: Journal  
LANGUAGE: ENGLISH

**An analyzer for in-line measurement of expiratory sulfur hexafluoride concentration**

An infrared analyzer for the **inert tracer gas sulfur hexafluoride** (SFinf 6) is described and **evaluated**. The analyzer consists of a transducer and a processor unit. It is designed to operate in a nonbreathing system with a **ventilator** and a computer. The transducer, which is placed over a cuvette with windows in the **ventilator** tubings, reads the SFinf 6 **concentration** in the airway during the expiratory phase. At the end of the inspiratory phase, the...  
...response time and linearity of the analyzer were tested, and interference by other gases was **assessed**. Full response was reached within 20 ms after a sudden introduction of 0.5% SFinf...

...cuvette. The analyzer-computer system had adequate linearity below 0.5% of SFinf 6. Oxygen, **nitrogen**, and humid air had no influence on the analyzer signal. One hundred per cent **nitrous oxide**, 4% enflurane, 4% isoflurane, and 4% halothane caused signals corresponding to 0.010, 0.023, 0.022, and 0.043% SFinf 6, respectively. Due to the **method** of zero reset, the importance of interference from these gases is greatly reduced when inspired and expired **concentration** approach each other. The disturbance from COinf 2 (10% COinf 2 gave a signal corresponding...

...of the analyzer may make it useful for studies of pulmonary gas mixing and for **measurements of lung volume** during mechanical **ventilation**.  
DRUG DESCRIPTORS:

\*enflurane; \*halothane; \*isoflurane; \* **nitrous oxide** ; \* **sulfur hexafluoride**

MEDICAL DESCRIPTORS:

\* **anesthesia** ; \*drug **determination** ; \*drug **elimination** ; \*gas analysis; \* lung function test

**anesthetic** equipment; functional residual capacity; **measurement** ; priority journal; drug analysis; **respiratory system** ; methodology; human ; normal human; diagnosis; human experiment

...CAS REGISTRY NO.: 66524-48-9 (halothane); 26675-46-7 (isoflurane);  
10024-97-2 ( **nitrous oxide** ); 2551 -62-4 ( **sulfur hexafluoride** )

SECTION HEADINGS:

037 Drug Literature Index

024 **Anesthesiology**

027 Biophysics, Bioengineering and Medical Instrumentation

1985

35/3,K/118 (Item 55 from file: 73)  
DIALOG(R)File 73:EMBASE  
(c) 2004 Elsevier Science B.V. All rts. reserv.

01668402 EMBASE No: 1980099694

**A simple helium -dilution method for the determination of functional residual capacity in artificially ventilated patients**

EINE EINFACHE HELIUMVERDÜNNUNGSMETHODE ZUR BESTIMMUNG DER FUNKTIONELLEN RESIDUALKAPAZITÄT BEIM MASCHINELL BEATMETEN KRANKEN

Rung I.; Kaemmerer H.; Klaschik E.

Inst. Anaesthesiol., Univ. Köln Germany

Anaesthetist ( ANAESTHESIST ) (Germany) 1980, 29/3 (148-151)

CODEN: ANATA

DOCUMENT TYPE: Journal

LANGUAGE: GERMAN SUMMARY LANGUAGE: ENGLISH

**A simple helium -dilution method for the determination of functional residual capacity in artificially ventilated patients**

A convenient modification of the classical closed circuit **helium** dilution **technique** was developed to **determine** functional residual capacity, especially in intubated and artificial **ventilated** patients. The **determination** of the still inflatable **lung volume** and its variability in the course of pulmonary insufficiency or after a change in the **adjustment** of the **respirator** ( **PEEP** a.o.), was reproducible better than +/-10%. This **method** can be performed in a short time, without risk for the patient and with instruments...

DRUG DESCRIPTORS:

\* **helium**

MEDICAL DESCRIPTORS:

\*artificial **ventilation** ; \*functional residual capacity  
methodology; diagnosis; **respiratory** system

CAS REGISTRY NO.: 7440-59-7 ( **helium** )

SECTION HEADINGS:

024 **Anesthesiology**

015 Chest Diseases, Thoracic Surgery and Tuberculosis

027 Biophysics, Bioengineering and Medical Instrumentation

1980

35/3,K/120 (Item 57 from file: 73)  
DIALOG(R)File 73:EMBASE  
(c) 2004 Elsevier Science B.V. All rts. reserv.

00840840 EMBASE No: 1977186394

**Closing capacity** measurement during genral anesthesia  
Gilmour I.; Burnham M.; Craig D.B.  
Dept. Anesth., Univ. Manitoba, Hlth Sci. Cent., Winnipeg Canada  
Anesthesiology ( ANESTHESIOLOGY ) 1976, 45/5 (477-482)  
CODEN: ANESA  
DOCUMENT TYPE: Journal  
LANGUAGE: ENGLISH

**Closing capacity** measurement during genral anesthesia

A modification of the single **breath nitrogen** closing volume (CV) test allows **measurement** of closing capacity (CC) during general **anesthesia**. In the modification, **inspiration** and expiration are mechanically produced by a hydraulically powered cylinder. For 14 awake, normal subjects, results of the CV test performed using this mechanical **method** differed than those obtained following spontaneous **inspiration** and expiration. Mean (+/-SE) CC's were 2.25 (+/-0.15) and 2.42 l (+/-0.14) (P <0.01) using spontaneous and mechanical **methods**, respectively. The slopes of Phase III of the CV traces were 2.24 (+/-0.27) and 2.66 per cent Ninf 2/1 (+/-0.32) (P<0.01), respectively. To **eliminate** differences due to **measurement technique**, the modified CV test was used both before and during **anesthesia** with halothane in 70 per cent Ninf 2 in 11 normal, supine, spontaneously **breathing** subjects. CC's were 1.89 l (+/-0.16) before and 1.81 l (+/-0.15) during **anesthesia** (P>.5). Mean functional residual capacities (FRC) by the closed circuit **helium method** were 1.77 l (+/-0.15) before and 1.45 l (+/-0.17) during **anesthesia** (P<.001). With CC unchanged and FRC decreased following induction, CC/FRC increased from 1...

...0.08) to 1.37 (+/-0.11) (P<.005), suggesting increased small airway closure during **anesthesia**.

DRUG DESCRIPTORS:

\*halothane; \* **nitrous oxide** ; \*suxamethonium; \*thiopental; \*tubocurarine chloride

MEDICAL DESCRIPTORS:

\*airway obstruction; \* **anesthesia** ; \*apparatus; \*artificial ventilation ; \* **lung** ; \* **lung function** ; \* **lung ventilation** ; \* **lung volume**

theoretical study; normal human; **inhalational** drug administration; major clinical study; therapy; methodology

...CAS REGISTRY NO.: 66524-48-9 (halothane); 10024-97-2 ( **nitrous oxide** ); 306-40-1...

SECTION HEADINGS:

037 Drug Literature Index

024 **Anesthesiology**

015 Chest Diseases, Thoracic Surgery and Tuberculosis

1976

35/3,K/142 (Item 3 from file: 155)  
DIALOG(R)File 155:MEDLINE(R)  
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14009140 PMID: 9710101

**Single- breath CO2 analysis as a predictor of lung volume in a healthy animal model during controlled ventilation .**

Stenz R I; Grenier B; Thompson J E; Arnold J H  
Department of Anesthesia, Children's Hospital, Harvard Medical School, Boston, MA 02115, USA.

Critical care medicine (UNITED STATES) Aug 1998 , 26 (8) p1409-13, ISSN 0090-3493 Journal Code: 0355501

Document type: Journal Article

Languages: ENGLISH

Main Citation Owner: NLM

Record type: Completed

**Single- breath CO2 analysis as a predictor of lung volume in a healthy animal model during controlled ventilation .**

Aug 1998 ,

OBJECTIVE: To examine the utility of single- **breath CO2 analysis as a measure of lung volume** . DESIGN: A prospective, animal cohort study comparing 21 parameters derived from single- **breath CO2 analysis with lung volume measurements determined by nitrogen washout** in animals during controlled **ventilation** . SETTING: An animal laboratory in a university-affiliated medical center. SUBJECTS: Seven healthy lambs. INTERVENTIONS: The single- **breath CO2 analysis station** consists of a mainstream capnometer, a variable orifice pneumotachometer, a signal processor and...

... capability for both on- and off-line data analysis. Twenty-one derived components of the **CO2 expirogram** were **evaluated** as predictors of **lung volume** . **Lung volume** was manipulated by 3 cm H2O incremental increases in **positive end - expiratory pressure** from 0 to 21 cm H2O, and ranged between 147 and 942 mL. **MEASUREMENTS AND MAIN RESULTS:** Fifty-five **measurements of lung volume** were available for comparison with derived variables from the **CO2 expirogram**. Stepwise linear regression identified four variables that were most predictive of **lung volume** : a) dynamic **lung compliance**; b) the slope of phase 3; c) the slope of phase 2 divided by the mixed expired **CO2 tension**; and d) airway deadspace. The multivariate equation was highly statistically significant and explained 94% of the variance ( **adjusted r2 = .94**,  $p < .0001$ ). The bias and precision of the **calculated lung volume** was .00 and 51, respectively. The mean **percent difference for the lung volume estimate** derived from the single- **breath CO2 analysis station** was 0.79%. **CONCLUSIONS:** Our data indicate that analysis of the **CO2 expirogram** can yield accurate information about **lung volume** . Specifically, four variables derived from a plot of expired **CO2 concentration** vs. expired **volume** predict changes in **lung volume** in healthy lambs with an **adjusted coefficient of determination** of .94. Prospective application of this technology in the setting of lung injury and rapidly changing physiology is essential in **determining the clinical usefulness of the technique** .

Descriptors: \*Carbo n Dioxide --analysis--AN; \* Lung Volume Measurements -- methods --MT; \*Positive-Pressure Respiration ; \*Total Lung Capacity ; Animals; Animals, Newborn; Biological Markers --analysis--AN; Lung; Respiratory Dead Space; Sheep; Ventilation -Perfusion Ratio

CAS Registry No.: 0 (Biological Markers); 124-38-9 (Carbon Dioxide)

Chemical Name: Biological Markers ; Carbon Dioxide

35/3,K/160 (Item 21 from file: 155)  
DIALOG(R)File 155:MEDLINE(R)  
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08481834 PMID: 2630761

[Simultaneous analysis of the distribution of ventilation and diffusive conductance to perfusion in the lungs]

Yamaguchi K

Nihon Kyobu Shikkan Gakkai zasshi (JAPAN) Dec 1989 , 27 (12)  
p1407-17, ISSN 0301-1542 Journal Code: 7505737

Document type: Journal Article ; English Abstract

Languages: JAPANESE

Main Citation Owner: NLM

Record type: Completed

[Simultaneous analysis of the distribution of ventilation and diffusive conductance to perfusion in the lungs]

Dec 1989 ,

Theoretical analysis and experimental observations were performed to establish an essential **method** allowing demonstration of the characteristics of distribution of **ventilation** (VA) as well as of diffusive conductance (G) to perfusion (Q) in the lungs. O<sub>2</sub>, CO<sub>2</sub> and CO binding to hemoglobin molecules within erythrocytes, together with six **inert gases** including SF<sub>6</sub>, ethane, cyclopropane, halothane, diethyl ether and acetone, possessing various degrees of solubility in blood and...  
...a supine position, were given a mixture of 21% O<sub>2</sub> and 0.1% CO in N<sub>2</sub> as the inspired gas and normal saline containing appropriate amounts of the six **inert gases** via the antecubital vein. After a steady state was established, the expired gas was collected...

... by gas chromatography, with electrodes or with Scholander gas analyzer. Assuming that the mass transfer **efficiency** of a given indicator **gas** at each **gas exchange** unit would be limited by the ratio of VA to Q (VA/Q) and by...

... axes, respectively. The numerical analysis including the procedure of a simultaneous Bohr integration for O<sub>2</sub>, CO<sub>2</sub> and CO in a pulmonary capillary and the **method** of weighted least-squares combined with the idea of constrained optimization permitted the data to...

Descriptors: \*Pulmonary Diffusing Capacity; \* Pulmonary Gas Exchange; \* Ventilation -Perfusion Ratio; Lung--physiopathology--PP; Methods; Pulmonary Fibrosis--physiopathology--PP

35/3,K/162 (Item 23 from file: 155)  
DIALOG(R)File 155:MEDLINE(R)  
(c) format only 2004 The Dialog Corp. All rts. reserv.

06978205 PMID: 3934636

**A simple method for measuring functional residual capacity by N2 washout in small animals and newborn infants.**

Gerhardt T; Hehre D; Bancalari E; Watson H

Pediatric research (UNITED STATES) Nov 1985 , 19 (11) p1165-9,  
ISSN 0031-3998 Journal Code: 0100714

Contract/Grant No.: 5 RO1 HL25023-04; HL; NHLBI

Document type: Journal Article

Languages: ENGLISH

Main Citation Owner: NLM

Record type: Completed

**A simple method for measuring functional residual capacity by N2 washout in small animals and newborn infants.**

Nov 1985 ,

An open circuit N2 washout technique is described for the determination of functional residual capacity in infants. Either 100% O2 or any oxygen/ helium mixture can be used as the washing gas. The subject breathes the washing gas through a T-tube and the washed out nitrogen is mixed with this gas in a mixing chamber, placed into the exhalation part of the circuit. The N2 concentration of the mixed gas is analyzed continuously, and the concentration signal is electronically integrated over time. Calibration of the system is accomplished by injecting known amounts of nitrogen or room air into the circuit. The gas flow through the system must remain constant and is adjusted to approximate peak inspiratory flow of the infant. In vitro testing of the system showed...

... 1.0%) and that the integrated signal output has a close linear correlation with the amount of N2 washed out ( $r = 0.99$ ). In vivo measurements in 10 cats confirmed the accuracy and reproducibility of the method when compared with N2 collection. The technical advantages of the system are simplicity of components, absence of valves, easy calibration, low dead space, and no need to collect or measure expired gases. For the infant this means no added resistance during washout and no risk...

... as needed. There is no lower limit of weight or size for functional residual capacity measurements in small infants or animals.

Descriptors: \*Functional Residual Capacity ; \* Lung Volume Measurements ; \* Nitrogen --metabolism--ME; Animals; Carbon Dioxide ; Cats; Infant, Newborn; Methods ; Oxygen; Respiration

CAS Registry No.: 124-38-9 (Carbon Dioxide) ; 7727-37-9 (Nitrogen) ; 7782-44-7 (Oxygen)

Chemical Name: Carbon Dioxide ; Nitrogen ; Oxygen



35/3,K/165 (Item 26 from file: 155)  
DIALOG(R) File 155:MEDLINE(R)  
(c) format only 2004 The Dialog Corp. All rts. reserv.

06342127 PMID: 6662770

**Gas mixing in dog lungs studied by single- breath washout of He and SF6 .**

Meyer M; Hook C; Rieke H; Piiper J

Journal of applied physiology- respiratory, environmental and exercise physiology (UNITED STATES) Dec 1983 , 55 (6) p1795-802, ISSN 0161-7567 Journal Code: 7801242

Document type: Journal Article

Languages: ENGLISH

Main Citation Owner: NLM

Record type: Completed

**Gas mixing in dog lungs studied by single- breath washout of He and SF6 .**

Dec 1983 ,

Simultaneously measured helium ( He ) and sulfur hexafluoride ( SF6 ) single- breath washout was studied in 16 anesthetized paralyzed dogs ventilated with a special hydraulically operated ventilatory servo system. After equilibration of lung gas with 1% He and 1% SF6 , the maneuver consisting of inspiration of a test gas-free mixture at constant rate (VI), a variable time of breath holding, and an expiration at constant rate (VE), was performed. Fractional concentrations of He and SF6 , recorded against expired volume, were analyzed in terms of slope of the alveolar plateau (S...

...l/s,  $VE = 0.1 \text{ l/s}$ ) S was about 10% of alveolar-to-inspired concentration difference per liter expirate both for He and SF6 . Both SHe and SSF6 were inversely related to VI and VE, the relative changes being...

... than unity depending on VI and VE. Both SHe and SSF6 decreased with increasing preinspiratory lung volume . Breath holding up to 10 s slightly decreased SHe and SSF6 while SHe/SSF6 was unchanged. The contribution of continuing gas exchange to S assessed from comparative measurements using the reversed (single breath washin) technique ranged from 6 to 23% in the various conditions. The VDHe/VDSF6 ratio...

... in the dog lung and the mechanism accounting for S are little diffusion dependent. By exclusion sequential filling and emptying of lung units is believed to constitute the most important mechanism...

Descriptors: \*Fluorides--diagnostic use--DU; \* Helium --diagnostic use--DU; \*Lung--physiology--PH; \* Sulfur Hexafluoride --diagnostic use--DU; Animals; Dogs; Methods ; Pulmonary Alveoli--physiology--PH; Respiration ; Respiratory Dead Space ; Respiratory Function Tests

CAS Registry No.: 0 (Fluorides); 2551-62-4 (Sulfur Hexafluoride) ; 7440-59-7 (Helium)

Chemical Name: Fluorides; Sulfur Hexafluoride ; Helium

35/3,K/173 (Item 34 from file: 155)  
DIALOG(R)File 155:MEDLINE(R)  
(c) format only 2004 The Dialog Corp. All rts. reserv.

04007198 PMID: 1126902 Record Identifier: 75151383

**Pulmonary blood flow determined by continuous analysis of pulmonary N2O exchange.**

Stout R L; Wessel H U; Paul M H

Journal of applied physiology (UNITED STATES) May 1975 , 38 (5)  
p913-8, ISSN 0021-8987 Journal Code: 0376576

Document type: Journal Article

Languages: ENGLISH

Main Citation Owner: NLM

Other Citation Owner: NASA

Record type: Completed

**Pulmonary blood flow determined by continuous analysis of pulmonary N2O exchange.**

May 1975 ,

Measurement of mean pulmonary blood flow (Qp) as a function of pulmonary inert gas ( N2O ) uptake was studied with the aid of a mathematical model, fast response measurement of gas...

... the mouth, and digital computer analysis of the data. The model treats the total pulmonary inert gas uptake as the sum of dead space, alveolar, lung tissue, and pulmonary blood flow uptakes. Analysis of any two breaths during breathing of a gas mixture (39 percent N2O , 21 percent O2, 40 percent N2 or He ) in terms of the soluble ( N2O ) and the insoluble ( N2 or He ) inert gas yields two simultaneous equations with two unknowns which can be solved for Qp. No assumptions are required about the magnitude of the alveolar, dead space, or lung tissue volumes and constant FRC is not a requirement. The validity of the mathematical model and its sensitivity to known measurement errors was studied by computer simulation of respiratory gas exchange for N2O and N2 . Comparison of Qp ( N2O ) with the direct Fick method (O2) in five anesthetized dogs showed agreement within plus or minus 20 percent. The proposed method has promise as a clinical method for determination of cardiac output on a breath -to- breath basis during regular breathing at rest or during exercise.

Descriptors: \*Models, Biological; \* Nitrous Oxide ; \*Pulmonary Circulation; Animals; Cardiac Output; Computers; Dogs; Lung Volume Measurements; Mathematics; Respiratory Dead Space

CAS Registry No.: 10024-97-2 (Nitrous Oxide)

Chemical Name: Nitrous Oxide

LUNG  
VOLUME  
or  
FRC  
is  
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Set	Items	Description
S1	412214	RESPIRAT? OR INSUFFLAT? OR VENTILAT? OR BREATHE? OR BREATH- ING OR INHALAT? OR PCV OR VCV OR PEEP OR POSITIVE()END()EXPIR- ?()PRESSUR?
S2	6562	(LUNG? OR PULMON?) (5N) (CAPACIT? OR VOLUM?)
S3	1727	(GAS OR GASES OR GASSES) (3N) (FLOW? OR EXCHANG? OR BACK(2W)- FORTH) (3N) (EFFICIEN? OR EFFICAC? OR EFFECTIVENESS? OR HOMOGEN? OR INHOMOGEN? OR EQUILIBRIUM? OR PERFORM? OR FUNCTION?)
S4	175245	BREATH?() (GAS OR GASES OR GASSES) OR ANESTH? OR ANAESTH? OR NITROUS()OXID? OR LAUGHING()GAS OR N2O OR N()SUB()2()O OR CA- RBON()DIOXID? OR CO2 OR CO()SUB()2 OR CARBONIC()ANHYDRID?
S5	0	RN=(124-38-9 OR 10024-97-2)
S6	8710479	CONCENTRATION? OR STRENGTH? OR PERCENT? OR POTENC? OR DILU- T?(2N) (RATIO? OR FACTOR? OR MIXTUR? OR ADMIX?) OR AMOUNT? OR - CONTENT
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S8	240791	BREATH OR BREATHS OR INSPIRATION? OR INHALATION? OR ENDBRE- ATH? OR TIDALBREATH?
S9	4903122	ELIMINAT? OR RID OR RIDS OR RIDDING OR REMOV? OR EXPURG? OR PURG? OR SUBTRACT? OR ADJUST? OR EXCLUD? OR EXCLUS?
S10	81057	(INERT OR NOBLE) (2N) (GAS OR GASES OR GASSES) OR ANESTH? OR ANAESTH? OR FLUOROPROPAN? OR FLUORO()PROPAN? OR HFC()281 OR H- FC281 OR HYDROFLUOROCARBON()281
S11	7076687	NITROGEN OR N()SUB()2 OR N2 OR HELIUM OR HE OR (SULFUR OR - SULPHUR) (FLUORID? OR HEXAFLUORID?) OR ELEGAS OR SF6 OR SF()- SUB()6
S12	0	RN=(7440-59-7 OR 2551-62-4 OR 7727-37-9)
S13	511846	TRACER? OR MARKER? OR INDICATOR?
S14	1605694	METHOD OR METHODS
S15	4828	S1 AND S2
S16	4326	S15 AND (S14 OR SYSTEM? OR PROCEDURE? OR PROCESS?? OR TECH- NIQUE?)
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S19	1449	S18 AND S7
S20	1226	S18 AND S9
S21	1479	S19:S20
S22	545	S21 AND (S7 OR S9) (5N) (S4:S5 OR S10:S12)
S23	1196	S19 AND S20
S24	168	S23 AND S3
S25	517	S22 AND (S6 OR S13)
S26	173	S25 AND (S6 OR S13) (5N) (S4:S5 OR S10:S12)
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**Improvement of Gas Exchange , Pulmonary Function , and Lung Injury With  
Partial Liquid Ventilation (\*)**.

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**Improvement of Gas Exchange , Pulmonary Function , and Lung Injury With  
Partial Liquid Ventilation (\*)**.

TEXT:

A Study Model in a Setting of Severe **Respiratory** Failure  
Study objective: To **evaluate gas exchange , pulmonary function**  
, and lung histology during **gas ventilation** of the  
perfluorocarbon-filled lung compared with **gas ventilation** of the  
gas-filled lung in severe **respiratory** failure.

Study design: Application of gas (GV) or partial liquid (PLV)  
**ventilation** in lung-injured sheep.

Setting: A research laboratory at a university medical center.  
Subjects: Eleven...

...life support (ECLS) was instituted. For the first 30 min on ECLS, all  
animals were **ventilated** with gas. Over the ensuing 2.5 h, **ventilation**  
with 15 mL/kg gas was continued without intervention in the control group  
(GV, n=6) or with the addition of 35 mL/kg of perflubron (PLV, n=5).

**Measurements** and results: At 3 h after initiation of ECLS, Qps/Qt  
was significantly reduced in...

...performed on lung biopsy specimens demonstrated a marked reduction in  
lung injury in the liquid **ventilated** (LV) when compared with the GV  
animals.

Conclusion: In a model of severe **respiratory** failure, PLV improves  
pulmonary **gas exchange** and pulmonary **function** and is associated with  
a reduction in pulmonary pathology. (CHEST 1995; 108:500-08)

ARDS=acute **respiratory** distress syndrome; CA(0.sub.2)=(0.sub.2)  
**content** of arterial blood; Ci(0.sub.2)=(0.sub.2) **content** of the blood  
draining from the ideal alveolus as derived from the alveolar gas equation  
and the dissociation curve; Cv(0.sub.2)=(0.sub.2) **content** of mixed venous  
blood; ECLS =extracorporeal life support; ECLS-GE=extracorporeal life  
support with membrane lung gas exchange; (FIO.sub.2)=fraction of inspired  
oxygen; GV=gas **ventilation** ; LV=liquid **ventilation**  
P(A-a) (0.sub.2)=alveolar-arterial (0.sub.2) pressure difference;  
PA(0.sub.2)= alveolar partial pressure of oxygen; **PEEP = positive end -  
expiratory pressure** ; PLV=partial liquid **ventilation** ; Qps/  
Qt=physiologic shunt; TLV=total liquid **ventilation**

Key words: liquid **ventilation** ; mechanical **ventilation** ;  
perfluorocarbons; **respiratory** failure; flouorocarbons

The first report indicating the ability of perfluorocarbon liquid  
**breathing** to sustain life was provided by Clark and Gollan in 1966.(1)  
Since that time, numerous studies have provided data suggesting that liquid  
**ventilation** with perfluorocarbons might improve **gas exchange** and

pulmonary function in respiratory failure.(2) Most of this research on liquid ventilation has been performed using one of two techniques : (1) "total" liquid ventilation (TLV) in which the perfluorocarbon-filled lung is ventilated with tidal volumes of perfluorocarbon utilizing a "liquid ventilator "; and (2) "partial" liquid ventilation (PLV) in which gas ventilation of the perfluorocarbon-filled lung is performed utilizing a standard gas mechanical ventilator .(2,3) The advantage of the latter lies in its simplicity because the use of a specialized device is not required in order to perform this novel method of ventilation .

The majority of the investigative work performed on the subject of liquid ventilation has involved the use of TLV in premature animals with surfactant deficiency and respiratory distress syndrome.(4-6) Such studies have revealed a marked improvement in respiratory status in animals of very low gestational age.(4) Other studies have been performed evaluating the efficacy of TLV in older animal models of acute respiratory distress syndrome (ARDS).(7,8) We recently reported our experience with TLV in an animal model with oleic acid-induced severe lung injury.(9) However, few studies have assessed the efficacy of PLV in an older animal model of respiratory failure.(10-12) The purpose of this study, therefore, is to evaluate the ability of PLV to improve gas exchange and pulmonary function in severe respiratory failure in a nonneonatal large animal model.

#### METHODS

Eleven sheep, 17.1 (+ or -) 1.8 kg in weight, were anesthetized with a mixture containing 50 g/L of guaifenesin (Sigma Chemical; St. Louis) and 1...

...L of ketamine (Aveco; Fort Dodge, Iowa); 2.2 mL/kg was administered for initial anesthesia with titration to effect. A midline neck incision was performed, and the trachea was isolated and cannulated with a 9-mm inner diameter jet ventilation endotracheal tube (Mallinckrodt; St. Louis). The right carotid artery as well as both internal jugular veins were identified. An 18- gauge angiocatheter (Becton Dickinson Vascular Access; Sandy, Utah) was placed into the carotid artery and advanced...

...into the pulmonary artery via the right femoral vein. All pulmonary and arterial blood pressure measurements were assessed utilizing Sorenson Transpac II pressure transducers (Abbott Laboratories; North Chicago, Ill) and Hewlett-Packard signal...

...Medical Division; Andover, Mass). Pancuronium, 0.1 mg/kg, was administered intravenously, and gas mechanical ventilation was initiated. An anesthetic infusion of the guaifenesin-ketamine mixture was started at a rate of 2.2 mL...was placed to reduce abdominal distension. Animals remained in the supine position throughout all studies. Assessment was performed of baseline physiologic data, such as systemic arterial and pulmonary arterial pressures, ventilator settings and airway pressures, pulmonary compliance, temperature, and arterial and venous blood gases.

#### Technique of Extracorporeal Life Support

Heparin, 100 units/kg, was administered intravenously. A 23F venous drainage...

...was re-circulated, warmed, and oxygenated. Calcium and bicarbonate levels of the blood prime were assessed and adjusted to maintain the ionized calcium at 1.0 or more and the calculated base excess at -4.0 mEq/L or more. Venovenous bypass was initiated at a...

...through the extracorporeal device, but no contribution to gas exchange took place. Physiologic data, including systemic and pulmonary pressure,

pulmonary compliance, **ventilator** pressure, and blood gas data, were **assessed** after extracorporeal blood flow rate had been increased to 100 mL/kg/ min. Extracorporeal life support (ECLS) blood flow was **measured** using a Transonics flow meter (Transonic **Systems** ; Ithaca, NY), and a 0.25-inch tubing flow probe was placed on the infusion...

...injury, the fraction of inspired oxygen ((FIO.sub.2)) was increased to 1.0, and **ventilator** pressures were **adjusted** to maintain the Pa( CO . sub . 2 ) between 35 and 45 mm Hg. Maximum **ventilator** settings included a peak inspiratory pressure of 50 cm (H.sub.2)O, **positive end - expiratory pressure** ( **PEEP** ) of 4 cm (H.sub.2)O, and a **respiratory** rate of 30 breaths per minute. **Ventilator** pressures were **assessed** utilizing a Sechrist Model 400 airway pressure monitor (Sechrist Industries; Anaheim, Cal) attached to the carinal pressure port of the endotracheal tube. Physiologic data were **assessed** every 15 min. The presence of arterial hypoxemia (Pa(O.sub.2) (is less than...  
...P(A-a)(O.sub.2)) of 610 mm Hg, or more, which are clinical **indicators** of severe **respiratory** failure and predictive of high mortality, were utilized to indicate need for ECLS. Therefore, a...

...taking place. Once on ECLS with membrane lung gas exchange (ECLS-GE), physiologic data were **assessed** every 30 min. The venovenous extracorporeal blood flow rate in all groups was **adjusted** to maintain the arterial blood gas values with a Pa(O.sub.2) of 50 to 80 mm Hg and the membrane lung **ventilating** gas flow rate was **adjusted** to maintain the Pa( CO . sub . 2 ). at 35 to 45 mm Hg.

The ECLS blood flow rate was maintained at 10...

...avoid circuit thrombosis. For the first 30 min on ECLS-GE, all animals remained gas **ventilated** . After 30 min of ECLS-GE, animals were randomized to management with gas **ventilation** (GV (n=6)) or PLV (n=5). Heparin, 100 units/kg, and pancuronium, 0.1...

...5 animals in each group. The GV and PLV animals were continued on gas mechanical **ventilation** which was increased to the "maximum" **ventilator** settings as described previously. The GV or PLV was continued with **assessment** of physiologic data every 15 min or until death of the animal. Those animals surviving for the predetermined 1-h period were euthanized with 0.2 mL/kg pentobarbital.

#### **Ventilation During ECLS-GE:**

During ECLS-GE, a Bennett MA-1 **ventilator** was utilized to provide GV at a tidal volume of 15 mL/kg, a **PEEP** of 4 cm (H.sub.2)O, and a rate of 10 breaths per min...

...both the GV and PLV animals. The (FIO.sub.2) was maintained at 1.0. **Ventilator** tidal volume settings were calibrated by spirometer to a demonstrated accuracy of (+ or -) 6%. End-expiratory pressures and **ventilator** rates were monitored by the Sechrist airway pressure monitor with an accuracy of pressure **measurement** of (+ or -) 3 cm (H.sub.2)O.

#### **Partial Liquid Ventilation**

Partial liquid **ventilation** was initiated by filling of the lungs with perflubron (perfluoro-octylbromide (LiquiVent(TM)), Alliance Pharmaceutical; San Diego), 30 mL/kg. Gas **ventilation** of the perflubron-filled lungs was then performed using the same settings as ... the endotracheal tube.

#### **Pulmonary Function**

Static total lung inflation and deflation compliance during GV was **assessed** by sequential endotracheal tube injections and then **removal** of 4 mL/kg of air with 5-s intervals between injections to a maximum...  
...10-mL calibrations was attached to the endotracheal tube and utilized to

instill and then **remove** the 4 mL/kg volumes of room air. Air trapping was tolerated to within 10% of the volume of gas injected or the compliance **measurement** was repeated. Static airway pressure **measurements** were **assessed** by a Cobe CDX III transducer (Cobe; Lakewood, Colo) attached directly to the carinal port...

...each experiment to a pressure of 30 cm (H.sub.2)O. Static airway pressure **measurement** accuracy and reproducibility were **assessed** over a range from 10 to 40 cm (H.sub.2)O. Mean airway pressure **measurement** reproducibility was 2.5% with a range of 2.0 to 11.2%, and mean **measurement** accuracy was 0.6 cm (H.sub.2)O with a range of 0.3...

...heparin-coated syringes, and (PO.sub.2), (PCO.sub.2), pt, oxygen saturation, hemoglobin, and **calculated** base deficit were immediately **assessed** by an ABL blood gas analyzer (Radiometer; Copenhagen, Denmark) and an OSM-3 cooximeter calibrated for sheep blood (Radiometer; Copenhagen, Denmark).

#### Lung Biopsy **Assessment**

All lungs were inflated to 10 cm (H.sub.2)O constant pressure, and the...

...specimens with hematoxylin and eosin staining and light microscopic analysis was performed. This allowed an **estimate** of the degree of intraalveolar hemorrhage, intraalveolar edema, and infiltration of inflammatory cells present.

#### Data Analysis

Baseline physiologic shunt ( $Q_{ps}/Q_t$ ) and  $P(A-a)$  (O.sub.2) were **calculated** based on **assessment** of arterial (O.sub.2) **content**, mixed venous (pulmonary artery catheter) (O.sub.2) **content**, alveolar end-capillary (O.sub.2) **content**, and  $P_a(CO_2)$  utilizing the following equation:

$$Q_{ps}/Q_t = (C_i(O_{2}) - C_a(O_{2})) / (C_i(O_{2}) - C_v(O_{2}))$$

...is physiologic shunt,  $Q_t$  is cardiac output,  $C_a(O_{2})$  is (O.sub.2) **content** of arterial blood,  $C_v(O_{2})$  is (O.sub.2) **content** of mixed venous blood, and  $C_i(O_{2})$  is (O.sub.2) **content** of the blood draining from the ideal alveolus **ventilated** with gas ( $FIO_2 = 1.0$ ) as derived from the alveolar gas equation and...

... $P_a(O_2)$  is alveolar partial pressure of oxygen and ( $P_{atm} - P_a(CO_2) - 47$ ) -  $P_a(CO_2)$ . Venovenous bypass allowed **measurement** of  $Q_{ps}/Q_t$  despite the influence of extracorporeal support upon gas exchange.

All physiologic data throughout this study were **evaluated** by repeated **measures** analysis of variance within each group over time and by a post hoc unpaired Student...

...most animals within minutes of discontinuation of ECLS.

Table 1--Physiologic Data Observed in Gas- **Ventilated** and Partial Liquid **Ventilated** Animals at Baseline, After Induction of Lung Injury, at 30-Min Intervals While on ECLS...

...10

PLV	7.48(+ or -).02	7.26(+ or -).08	7.44(+ or -).03
$P_a(CO_2)$ , mm Hg			
GV	37.3(+ or -)7.7	51.6(+ or -)17.0	33.2...08
PLV	7.36(+ or -).07	7.36(+ or -).05	7.37(+ or -).04
$P_a(CO_2)$ ,			



mm Hg			
GV	33.3(+ or -)5.8	31.2(+ or -)6.3	34.9...
...08			
PLV	7.35(+ or -).10	7.36(+ or -).06	7.35(+ or -).11
Pa( CO . sub . 2 ),			
mm Hg			
GV	34.3(+ or -)6.9	34.8(+ or -)8.1	
PLV	39...		

...and PLV animals are compared). After 30 min of ECLS, both animal groups remained gas **ventilated**. Within 60 min after initiation of PLV, significant and sustained reductions in physiologic shunt were...

...group (p (is less than) 0.001).  
(Figure 2 ILLUSTRATION OMITTED)

The pulmonary compliance as **measured** at 20 mL/kg inflation volume is demonstrated over time in Figure 3. Baseline compliance...

...0.05 by (chi square) analysis).

As is seen in Figure 4, the light microscopic **assessment** of GV biopsy specimens revealed substantial pulmonary vascular congestion, alveolar hemorrhage, alveolar proteinaceous fluid accumulation...

...OMITTED)  
DISCUSSION

There are at least 150,000 new cases of ARDS resulting in an **estimated** 40,000 deaths ...each year.(14) Despite multiple advances in intensive care management and the application of innovative **ventilation techniques** and therapeutic interventions, including **PEEP**; ECLS, differential lung **ventilation**, inverse ratio **ventilation**, and surfactant administration, the mortality in severe **respiratory** failure in the nonneonatal population remains approximately 50%.(14-20) There is still a need, therefore, for effective **ventilatory** and pulmonary management in severe ARDS.

That liquid **breathing** could be a reality was first realized in 1962 when Kylstra et al(21) demonstrated...

...Gollan(1) subsequently revealed the unique ability of perfluorocarbons to sustain life in the spontaneously **breathing** mouse. Over the following three decades, numerous publications **evaluated** the ability of a variety of perfluorocarbons to provide gas exchange during liquid **breathing**.(22) A device intended to provide demand-controlled **ventilation** in normal canines was developed by Shaffer, and Moskowitz(23) in 1974. The **ventilator** settings which produced optimal alveolar **ventilation** and **carbon dioxide elimination** during TLV were subsequently established, and the effects of TLV upon gas exchange, pulmonary vascular resistance, and cardiac output were defined.(7,24-29) Other investigators **evaluated** the uptake, distribution, and **elimination** of perfluorocarbons as the safety of liquid **ventilation** with perfluorocarbons was demonstrated.(30-38) Additional studies documented the **efficacy** of TLV with perfluorocarbons in improving **gas exchange** and pulmonary **function** in premature, surfactant-deficient animals.(4-6,49,40) In 1989, the first human trials of **ventilation** with perfluorocarbons documented the ability of TLV to support gas exchange in moribund premature human neonates.(41,42) However, studies **assessing** the efficacy of TLV in nonneonatal animal models have been limited. Studies by Calderwood et...

...with perfluorocarbons in an adult feline ARDS model. Our group recently

demonstrated an improvement in **gas exchange** and pulmonary **function** during TLV in a young sheep ARDS model.(9,43)

In 1991, Fuhrman et al(3) published a report demonstrating the ability to provide adequate **gas exchange** during PLV. Subsequent investigation revealed that **gas exchange** and pulmonary **function** were improved during PLV in premature newborn surfactant-deficient and full-term neonatal gastric acid aspiration models.(6,44) However, few studies have **evaluated** the ability of PLV to improve **gas exchange** and pulmonary **function** in nonneonatal models of ARDS. Tutuncu et al(10,11) demonstrated an increase in **systemic** arterial oxygenation with PLV in a pulmonary saline-lavage adult rabbit model of ARDS. Curtis et al(12) documented the ability to enhance **systemic** oxygenation during PLV while maintaining hemodynamic stability in a lung-injured canine model. The current study also **evaluates** the efficacy of PLV in a non-newborn animal model of severe lung injury. Findings...

...an associated decrease in ECLS blood flow requirements during PLV in the setting of severe **respiratory** failure. We observed similar findings in our previous **evaluation** of TLV in the same lung injury model.(9) The mechanisms behind these observed improvements in gas exchange have not been delineated. We have demonstrated previously that **ventilation** with perfluorocarbon liquid enhances alveolar recruitment in the surfactant-deficient, atelectatic lung.(45) In addition, perfluorocarbons may displace intra-alveolar exudate, thereby enhancing gas exchange and **ventilation** -perfusion matching. A number of studies have now documented the heterogeneous nature of lung injury and function in **respiratory** failure.(46,47) Specifically, it is the dependent regions of the lungs which appear to be most affected in lung injury and which are predominantly consolidated and poorly **ventilated**. The nondependent regions, in contrast, remain relatively well aerated with less evidence of compromise in lung function. One of the specific advantages of liquid **ventilation** with perfluorocarbons may be that the relatively high-density perfluorocarbons (specific gravity, approximately 1.9...

...27) This redistribution of pulmonary blood flow may, in turn, lead to an improvement in **ventilation** -perfusion matching. Finally, the role that the perfluorocarbon-associated amelioration of lung injury, which was...

...recoil.(48) Neergard,(49) in 1929, demonstrated that pulmonary compliance was markedly improved during liquid **ventilation** of the liquid-filled lung when compared with gas **ventilation** of the gas-filled lung. We also observed an increase in pulmonary compliance during PLV (gas **ventilation** of the liquid-filled lung) when compared with GV in this lung injury model. Further clinical studies will be required to **determine** whether the use of PLV in patients with ARDS will be associated with an increase in compliance such that airway pressures and **ventilator** -induced lung injury may be reduced.(50)

Histopathologic **evaluation** of lung biopsy specimens in the GV group revealed findings that were consistent with ARDS...

...congestion, and parenchymal and intra-alveolar edema. In contrast, these findings were markedly diminished upon **evaluation** of the lung biopsy specimens from the PLV group. These are conclusions based on observations

...properties and that leukocyte function may be diminished following exposure to perfluorocarbons.(51,52) Acute **respiratory** insufficiency and the subsequent development of pulmonary fibrosis are largely secondary to the intraalveolar and...

...lung injury could prove to be a crucial factor in the management of

patients with **respiratory** failure.

In this study, a combination of two accepted models of **respiratory** failure were utilized to produce a severe lung injury. (54,55) Pulmonary saline lavage provides...

...15,20) The ECLS was used in this model to maintain viability and stability during **evaluation** of GV versus PLV. In addition, ECLS allowed demonstration of the potential benefits of PLV to those adult and pediatric patients with **respiratory** failure who currently have an expected mortality of approximately 50% despite intervention with ECLS. (56...

...performance of PLV in this study. However, this was an acute animal model, and therefore, **evaluation** of long-term safety of PLV was not possible. Previous studies have **evaluated** the short- and long-term **systemic** distribution and effect of various perfluorocarbons following liquid **ventilation**. (30-32) Although small in quantity, blood levels of perfluorocarbon are noted to increase steadily over the first half hour after onset of liquid **ventilation** and then to fall rapidly over the ensuing days with minute quantities, approximately 0.02 mg/100 mL of blood, remaining approximately 10 days after liquid **ventilation**. Trace **amounts** of perfluorocarbon (0.1 mg/g of tissue) have been noted in the lungs of animals up to 2 years after liquid **ventilation** with even smaller **amounts** present in other tissues over the same time period. (30,32) Light microscopic analysis of...

...a moderate polymorphonuclear leukocyte infiltration which was observed in both GV as well as liquid **ventilated** neonates. Other studies specifically **assessing** the safety of long-term performance of PLV with perflubron have failed to reveal any...

...is worthwhile to note that serum perflubron levels are extremely low during and following liquid **ventilation** which reduces the potential for **systemic** effects.

Whether **gas exchange** and pulmonary **function** will improve during PLV in patients with severe **respiratory** failure can only be **determined** in the clinical setting. Studies which will **evaluate** the efficacy of PLV in newborn, pediatric, and adult patients with **respiratory** insufficiency are under way. In the meantime, this study serves to document the effectiveness of lung management with PLV in reducing alveolar pathology and inflammatory infiltration while simultaneously improving **gas exchange** and pulmonary **function** in a model of acute, severe **respiratory** failure.

ACKNOWLEDGMENT: The authors wish to thank Robin Kunkle for assistance with lung biopsy histology preparation.

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**Correction of single-breath helium lung volumes in patients with  
airflow obstruction.**

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**Correction of single-breath helium lung volumes in patients with  
airflow obstruction.**

TEXT:

Study objective: To **determine** whether alveolar volume ((V.sub.A))  
**measured** during the single-breath diffusing capacity for carbon monoxide  
(Dco) can be used as a substitute **measure** for the multiple-breath total  
**lung capacity** (TLC) in subjects with and without airways obstruction.  
... JHH) and the Johns Hopkins Asthma and Allergy Center (JHAAC).

Participants: Patients referred for spirometry, **helium lung  
volumes**, and Dco during a single visit between November 1993 and November  
1996.

Results: JHAAC patients (n=2,477) were used to **assess** the  
relationship between (V.sub.A) and TLC. In patients with an (FEV.sub.1...

...patients with an (FEV.sub.1)/FVC (is less than) 0.70, (V.sub.A)  
**systematically** underestimated TLC ((V.sub.A)/TLC=0.67 to 0.94). The degree  
of underestimation...

...correlation coefficient (r)=0.96 to 0.99; p (is less than) 0.05). After  
**adjusting** for the severity of airflow obstruction, patients with an  
(FEV.sub.1)/FVC in the...

...A) for the severity of obstruction improves the accuracy of this  
relatively simple and rapid **technique** for **measuring** TLC.

(CHEST 1998; 114:907-918)

Key words: airflow obstruction; **lung volumes**; multiple-breath  
**helium** dilution; single-breath **helium** dilution

Abbreviations: c(V.sub.A)=alveolar volume corrected for the severity  
of airflow obstruction...

...PFT=pulmonary function test; r= Pearson's correlation coefficient;  
RV=residual volume; SVC=slow vital **capacity**; TLC=total **lung capacity**;  
(V.sub.A)=alveolar **volume**

Multiple-breath **helium** dilution and single-breath **helium** dilution  
are widely used pulmonary function tests (PFTs) for the **measurement** of  
static **lung volumes**. In many **pulmonary** function laboratories, total  
**lung capacity** (TLC) is routinely **measured** with the multiple-breath  
closed-circuit **helium** dilution **technique**. Single-breath **helium**  
dilution, by contrast, is usually included with the **measurement** of  
**pulmonary** diffusing **capacity** for carbon monoxide (Dco) and provides an  
**estimate** of TLC, commonly referred to as alveolar volume ((V.sub.A)).

Several investigators have previously...

...airflow obstruction remains undetermined. Furthermore, the clinical

utility of (V.sub.A) as a substitute **measure** of the multiple-breath TLC is not well defined. The present study was therefore designed to: (1) **determine** the effect of airflow obstruction on the accuracy of single-breath **technique** to predict the multiple-breath TLC, and (2) establish whether (V.sub.A) can be used as an **estimate** for multiple-breath TLC in normal and diseased patients. Since single-breath **helium** dilution is a relatively rapid and simple **technique**, it could potentially be used as a substitute **measure** for the multiple-breath **method** to simplify field studies and reduce the cost of clinical testing.

#### MATERIALS AND METHODS

We conducted a retrospective review of PFT results for all patients referred to the pulmonary...

...all inpatients and outpatients were reviewed to identify those patients who had spirometry, closed-circuit **helium** lung volumes, and Dco **measured** during a single visit. To **eliminate** inclusion of multiple **measurements** on any one patient, only the first PFT recorded for each patient was selected for the study.

Standard **techniques** for pulmonary function testing, in general accordance with the American Thoracic Society guidelines, (6) are...

...was expressed as BTPS and was not corrected for anatomic deadspace, but was corrected for (CO . sub . 2 ) absorption. Spirometry was performed to obtain the (FEV.sub.1) and the FVC. Multiple-breath closed-circuit **helium** dilution was used to **measure** functional residual capacity (FRC). At the end of each multiple-breath **procedure**, slow vital capacity (SVC) and expiratory reserve volume were **measured** in triplicate. Residual volume (RV) was then **calculated** by **subtracting** the average expiratory reserve volume from the **measured** FRC. TLC was **determined** by adding the largest SVC to the **calculated** BV. (V.sub.A) and Dco were **measured** using the single-breath carbon monoxide **method** .(7)

Patients from both laboratories were categorized based on the type of **ventilatory** impairment. The following classifications and criteria were used: restrictive (TLC (is less than or equal...

...80% of predicted and (FEV.sub.1)/FVC (is less than) 0.80); or no **ventilatory** impairment (TLC (is ...TLC ratio was used as an index of discrepancy between the single- and multiple-breath **technique**. Severity of airflow obstruction was **assessed** using the (FEV.sub.1)/FVC ratio. Before developing a statistical model to describe the...

...analysis. The residuals around the fitted model were examined and the upper and lower fifth- **percentile** limits of the residual values were **determined** .(8)

The predictive validity of the proposed model was examined using the PFT records from patients in the JHH sample. For each patient, the model was used to **adjust** the **measured** (V.sub.A) for the severity of airflow obstruction. This **adjustment** involved two steps: first, each patient's (FEV.sub.1)/FVC ratio was used in the model to predict an expected (V.sub.A)/TLC ratio; second, the **measured** (V.sub.A) was then divided by the expected (V.sub.A)/TLC ratio to **estimate** the multiple-breath TLC. To **assess** the accuracy of the predictions, we **calculated** Pearson's correlation coefficients(8) (r) between the predicted and the **measured** values of the multiple-breath TLC. Two **estimates** for single-breath RV were obtained by **subtracting** the SVC and the FVC, respectively, from the predicted multiple-breath TLC. These single-breath RV **estimates** were compared to the multiple-breath RV. All descriptive statistics are presented as means (+ or...



...the time period of the study, a combined total of 6,063 patients had spirometry, **helium lung volumes** and Dco **measured** during a single visit to one of the two pulmonary function laboratories. Of the 3...21

While specific clinical diagnoses for the study population were not known, the type of **ventilatory** impairment for each patient was **determined**. In the JHAAC sample, 242 patients (9.8%) had a restrictive impairment, 1,572 had...

...63.5%), 274 (11.1%) had a mixed impairment, and 389 (15.7%) had no **ventilatory** impairment. The corresponding **percentages** for the JHH sample were 502 (17.4%), 1,168 (40.4%), 488 (16.9%), and 734 (25.4%), respectively.

Comparison of Single-Breath and Multiple-Breath **Helium** Dilution Patients at or above an (FEV.sub.1)/FVC threshold of 0.70 had...

...TLC ratio close to unity (Table 2). Below this threshold, single-breath (V.sub.A) **systematically** underestimated the multiple-breath TLC. As the severity of airflow obstruction increased, the discrepancy between the single- and multiple-breath **lung volumes** increased progressively (Fig 1). Subgroup analyses of patients with a purely obstructive defect showed a ...

...relationship, the (FEV.sub.1)/FVC threshold for agreement between the single- and multiple-breath **methods** was slightly lower ((FEV.sub.1)/FVC (is greater than or equal to) 0.60...

...with a purely restrictive defect, there was a good level of agreement between the two **techniques** independent of the severity of restriction (JHAAC: (V.sub.A)/TLC=1.01 (+ or -) 0.08; JHH: (V.sub.A)/TLC= 1.04 (+ or -) 0.11). Similarly, patients with no **ventilator** defects had a mean (V.sub.A)/TLC ratio of 0.98 (+ or -) 0.09...

...JHAAC sample and 1.00 (+ or -) 0.07 in the JHH sample. Substituting the largest **measured** SVC in place of FVC and defining airflow obstruction based on the (FEV.sub.1)...

...with stepwise addition of (FEV.sub.1) and FVC showed a minimal increase in the **amount** of variability explained by the added predictors. Thus, the most parsimonious regression equation was developed...

...the residuals around the fit were normally distributed and had a constant variance. Moreover, no **systematic** association between the residuals and (FEV.sub.1)/FVC or the ...70. This figure also displays the linear regression line with the upper and lower fifth- **percentile** limits of the residuals. Since there was reasonably good agreement between (V.sub.A) and...

...is greater than or equal to) 0.70, (V.sub.A) was used as an **estimate** for TLC in these patients. However, in patients with an (FEV.sub.1)/FVC ratio of (is less than) 0.70, an **adjustment** was performed for the severity of airflow obstruction. Using (V.sub.A) and the above...

...than) 0.70

where c(V.sub.A) is the "corrected" (V.sub.A) after **adjustment** for the severity of airflow obstruction.

(Figure 2 ILLUSTRATION OMITTED)

Validation of the Model

The JHH sample was used to **assess** the validity of the above model in predicting the multiple-breath TLC. The c(V.sub.A) was **determined** for each patient in this sample without any **exclusions** based on the quality

of the patient's PFTs. Among patients with an (FEV.sub...

...0.40 there was a high degree of correlation between (cV.sub.A) and the **measured** multiple-breath TLC ( $r=0.83$  to  $0.96$ ; Fig 3). However, in severely obstructed...

...increased with worsening obstruction (Fig 3), c(V.sub.A) was, on average, a better **estimate** of the multiple-breath TLC than was (V.sub.A).  
(Figure 3 ILLUSTRATION OMITTED)

We...

...1)/FVC ( $r=-0.39$ ;  $p$  (is less than)  $0.0001$ ). Consequently, single-breath RV **determined** by **subtracting** SVC from (cV.sub.A) better **estimated** the multiple-breath RV than did single-breath RV **determined** by **subtracting** FVC from (cV.sub.A) (Fig 4).

(Figure 4 ILLUSTRATION OMITTED)

#### DISCUSSION

The results of the current study demonstrate that single-breath **helium** dilution can accurately predict the multiple-breath TLC in normal subjects and in patients with...

...or equal to)  $0.70$ ). In patients with moderate to severe obstruction, however, single-breath **helium** dilution **systematically** underestimates the multiple-breath TLC. The magnitude of underestimation in these patients is directly related to the severity of underlying obstruction. Substantial improvement in the accuracy of the single-breath **estimate** of TLC is achieved if (V.sub.A) is **adjusted** for the degree of airflow obstruction.

Several studies have previously demonstrated that in the absence of airways obstruction, **lung volume measurements** by single- and multiple-breath **helium** dilution are essentially similar.(1-4) In the Epidemiology Standardization Project, Ferris(3) reported good...

...obstruction ((FEV.sub.1)/FVC (is less than)  $0.70$ ). This difference in TLC, as **measured** by these two **techniques**, progressively increased with the severity of airflow obstruction. Similarly, Van Ganse and coworkers(2) showed that single- and multiple-breath **helium** dilution produce comparable results in normal subjects but not in patients with airways obstruction. Their study also revealed that the difference in TLC by the two **techniques** was negatively correlated with the degree of airways obstruction. Moreover, they noted that as the breath-hold time during the single-breath **technique** was increased, the difference between the single- and multiple-breath TLC progressively diminished.

In a...

...9) used a similar approach to the one in our study and compared the TLC **measured** by single-breath **helium** dilution to that obtained by chest radiography in patients with an (FEV.sub.1)/FVC in the range of  $0.28$  to  $0.95$ . TLC by single-breath **helium** dilution was in close agreement with radiography in patients with an (FEV.sub.1)/FVC...

...linear regression model relating the effects of airflow obstruction on the discrepancy between the two **methods** revealed a slope coefficient of  $0.81$  for (FEV.sub.1)/FVC, which is close...

...are in disagreement with our conclusions. In one of the earliest studies on single-breath **helium** dilution, Mitchell and Renzetti(5) observed a high degree of correlation between the single- and...

...groups of patients, no significant difference was noted in the average TLC by these two **techniques**, leading the authors to recommend single-breath **helium** dilution for the routine **measurement** of TLC.

Similarly, Pecora and associates(10) also found that in normal subjects and in...a similar magnitude as the multiple-breath TLC. More recently, Kilburn et al(11) compared **measured lung volumes** in 16 patients with radiographically advanced absestosis by four **methods** : gas dilution (single- and multiple-breath), plethysmography, and radiography. While both gas dilution **methods** underestimated TLC, there was no significant difference between the single- and multiple-breath TLC. Surprisingly, single-breath **lung volumes** were closer to the plethysmographic and the radiographic **measurements** than were the volumes **measured** by the multiple-breath **technique** . These studies, however, were limited in that the inclusion of a relatively small number of...

...reduced the power for detecting a statistically significant difference between the single- and multiple-breath **methods** .

The conclusion that single-breath **helium** dilution underestimates the multiple-breath TLC in patients with airflow obstruction is an expected finding. **Lung volume measurements** by gas dilution are based on either the wash-in or the wash-out of a **tracer** gas from the lungs. Closed-circuit **helium** dilution involves **breathing** of a **helium** gas mixture from a closed-circuit spirometer with subsequent "wash-in" of **helium** into the lungs. This **method** can be performed with either a single- or multiple-breath **technique** . Single-breath **helium** dilution requires a vital capacity breath-hold of the **helium** gas mixture and is usually included with the **measurement** of DCO. Multiple-breath **helium** dilution, on the other hand, requires rebreathing of the **helium** gas mixture at FRC until equilibration of **helium** has occurred within the lungs. With either the single- or multiple-breath **technique** , **determination** of **lung volume** is based on knowing the initial volume of gas in the spirometer and the **amount** of **helium** dilution that has occurred during the test. The advantages of the closed-circuit **method** are that it is operationally simple and generally requires less patient effort than alternative **methods** of **lung volume measurement** , such as body plethysmography. Furthermore, both closed-circuit **techniques** , single-breath and multiple-breath, are reproducible in their **measurement** of TLC, with reported coefficients of variation of 2.7 and 4.8%, respectively.(3) Disadvantages of the closed-circuit **method** include the potential for errors in the **measurement** of **helium concentration** that can result either from the alinearity of **helium** gas analyzers or from leaks in the patient-spirometer **system** . There is also a waiting period before this test can be repeated to allow for re-equilibration with room air. Thus, multiple **determinations** of FRC with this **method** are less feasible. Moreover, since closed-circuit **helium** dilution involves the wash-in of the inspired **helium** into the lungs, it is able to **measure** only the **volume** of gas in the **lungs** that is in direct communication with the airways. It is well known that patients with COPD have a significant **amount** of noncommunicating or trapped gas in their lungs. Closed-circuit **helium** dilution and gas dilution **methods** , in general, are unable to **measure** this volume of trapped gas, and these **methods** yield **estimates** of TLC that are lower than those obtained by body plethysmography or radiography.(12-15...

...can be as high as 1 L in some patients.(14) The error in the **measurement** of TLC is even greater when single-breath **helium** dilution is compared to other **methods** , especially in patients with airways obstruction. The results from our study and from previous work...

...investigators, however, have demonstrated that by increasing the breath-holding time during the single-breath **technique** , one can achieve a better distribution of **helium** to poorly **ventilated** regions and thereby

improve the accuracy of the single-breath TLC.(2,16) Alternatively, as shown in our study, mathematically **adjusting** the single-breath **measurement** for the severity of airflow obstruction also can be used to obtain an accurate **estimate** of TLC.

In contrast to closed-circuit **helium** dilution (a **method** based on wash-in of **helium** into the lungs), the open-circuit **nitrogen** **method** is based on the wash-out of **nitrogen** from the lungs while **breathing** 100% (O.sub.2). Like the closed-circuit **method**, open-circuit **nitrogen** wash-out can also be performed with either a single- or multiple-breath **technique**. Single-breath **nitrogen** wash-out involves a vital capacity inspiration of 100% (O.sub.2) with subsequent **measurement** of the **nitrogen** **concentration** in the exhaled gas. Multiple-breath **nitrogen** wash-out, on the other hand, involves **breathing** of 100% (O.sub.2) with continuous collection of the exhaled gas and monitoring of the **nitrogen** **concentration** in this collection. As with the closed-circuit **method**, **lung** **volume** is **determined** by knowing the initial **concentration** of **nitrogen** in the lungs (usually assumed to be 0.81) and the **amount** of **nitrogen** washed out from the lungs during the test. The open-circuit **method** shares some of the disadvantages of the closed-circuit **method** including the potential for erroneous **measurements** either due to the nonlinearity of the **nitrogen** gas analyzers or from leaks in the **system**. Moreover, open-circuit **nitrogen** wash-out is also unable to **measure** the volume of "trapped" gas in patients with obstructive lung disease. Comparison of TLC **measurements** by single-breath **nitrogen** washout to those by plethysmography show a difference of 0.36 to 0.46 L...

...L in obstructed patients.(3) While this trend also holds true for the multiple-breath **technique**, the absolute difference is less when multiple-breath **nitrogen** wash-out is compared to closed-circuit **helium** dilution or plethysmography. With either the single- or multiple-breath **nitrogen** **technique**, the residual error in the **measurement** of TLC is directly related to the severity of airways obstruction.(12) An added source of error for the open-circuit **method** is the potential contribution of tissue **nitrogen** to the total **amount** of **nitrogen** collected during the washout period. Unlike **helium**, **nitrogen** is readily soluble in tissues and is **eliminated** from sources other than the lungs during the test. However, with appropriate **adjustments** for the volume of **nitrogen** **eliminated** from other tissues, there is a minimal loss in the accuracy of this **method** for **measuring** TLC.(17)

Despite these limitations, open-circuit **nitrogen** wash out is a reliable and useful **method** for **measuring** TLC. Repeated **measurements** of RV with multiple-breath **nitrogen** washout have a coefficient of variation of about 2.2%.(18) Single-breath **nitrogen** **measurements** of TLC are also reproducible, with a reported coefficient of variation of about 4.0%.(3) An advantage of the open-circuit **method**, relative to other **methods**, is its ability to **assess** the uniformity of gas distribution in the lungs. This is usually done with the single-breath **nitrogen** washout **technique** by plotting the **nitrogen** **concentration** at the mouth against the volume of exhaled gas.(19) After a vital capacity **inhalation** of 100% (O.sub.2), a characteristic pattern in the **elimination** of **nitrogen** is observed. This pattern consists of the initial **elimination** (phase I) of dead-space gas with no **nitrogen**, followed by a mixture of dead-space and alveolar gas resulting in a gradual increase in the **nitrogen** **concentration** (phase II). Subsequently, a sloping plateau in the **nitrogen** **concentration** is observed, which reflects the **elimination** of the alveolar gas (phase III). If the inspired 100% (O.sub.2) is evenly... all alveoli, the alveolar gas plateau will be horizontal. However, if there is inhomogeneity of **ventilation**, this plateau will have a gradual slope with the latter portion representing the **nitrogen** from slowly

emptying portions of the lungs. Thus, the slope of the alveolar gas plateau is used by some to **assess** the heterogeneity in **ventilation** and has been shown to be an important predictor of the **measurement** discrepancy between the open-circuit **method** and plethysmography. (12)

In contrast to gas dilution, body plethysmography and radiography are not limited in their ability of **measuring** only the volume of communicating gas. Both **methods** provide a **measurement** of the total volume of gas in the thorax whether it is in direct communication with the airways or not. For the plethysmographic **measurement** of TLC, the subject is seated in a sealed box and instructed to pant against...

...is no airflow during the panting maneuver, the accompanying change in alveolar pressure can be **measured** directly at the mouth. The **lung volume** changes associated with the compression and expansion of thoracic gas are derived either from the...

...volume plethysmograph. Application of Boyle's law to these pressure-volume changes, with appropriate thermodynamic **adjustments**, then permits the **calculation** of thoracic gas volume. Advantages of body plethysmography include its ability to **measure** the total volume of gas in the thorax, the relatively short duration of the test, and the potential for repeated **measurements** in the same patient. Moreover, the coefficient of variation of repeated **measurements** of thoracic gas volume by body plethysmography is about 4.4%. (3) There are, however, several limitations with this **method**. First, many patients cannot tolerate being in a sealed environment for even short time periods, and some are unable to adequately perform the required panting maneuver. Second, because plethysmography **measures** the volume of compressible gas within the thorax and abdomen, the inclusion of intra-abdominal gas may lead to substantial errors in the **measurement** of **lung volume**. (20) In most subjects, however, the error from this source is usually negligible if the panting maneuver is performed properly. The third limitation is that plethysmography may overestimate the **lung volume** in obstructed patients because of the incomplete transmission of the alveolar pressure swings to the mouth. Brown et al (21) showed that in asthmatic subjects, **measurement** of thoracic gas volume by body plethysmography was greater when the panting maneuver was performed near RV than when it was performed near TLC. This discrepancy in the **measured** TLC at different **lung volumes** increased with worsening degree of airflow obstruction. On the basis of these findings, the authors ...

...accurately reflected by the changes in the pressure at the mouth, which lead to inaccurate **estimates** of **lung volume**. To investigate this problem further, Shore et al (22) and Stanescu et al (23) compared **lung volume measurements** using esophageal pressure to **estimate** changes in alveolar pressure with **measurements** made by using changes in the mouth pressure. Both studies showed that in the presence...

...TLC was significantly greater when mouth pressure was used in place of esophageal pressure to **estimate** the changes in alveolar pressure. This difference in TLC was explained by the fact that...

...of between 0.5 and 1 Hz. (24,25) Given that body plethysmography may overestimate **lung volumes** in severely obstructed patients, Rodenstein and Stanescu (14) hypothesized that the observed discrepancy in **lung volume measurements** by plethysmography and gas dilution may be a combined effect of the ...of TLC by the gas dilution and the overestimation by plethysmography.

The other alternative for **measuring** the total volume of communicating and non-communicating gas in the thorax, besides body plethysmography, is chest radiography. The two most commonly used

radiographic **techniques** are the ellipsoid **method** of Barnhard et al(26) and the planimetry **method** of Harris et al.(27) The ellipsoidal **method** treats each hemithorax as a stack of ellipsoids of varying sizes to **determine lung volume** . Standard posterior-anterior and lateral chest radiographs are used to **determine** the length of major and minor axes and the height of each ellipsoid. The volumes of these ellipsoids are then summed and corrected for the cardiac, **pulmonary** , and blood **volumes** to obtain the radiographic **lung volume** . Planimetry, on the other hand, is based on the **calculation** of surface areas of the right and left hemithoraces. These surface areas are obtained with a planimeter and used in a regression equation to obtain the radiographic TLC. **Measurements** of TLC by radiography and plethysmography usually yield comparable results. In their original descriptions of the radiographic **technique** , both Harris et al(27) and Barnhard et al(26) noted a high degree of correlation ( $r$  is greater than) 0.83) between radiography and other **methods** . Similarly, radiographic **measurements** in the Epidemiology Standardization Project were in close agreement with the plethysmographic **measurements** and had a coefficient of variation of about 4.5%.(3) In contrast, Spence and...

...the intraindividual agreement between radiographic planimetry and plethysmography was poor. Additionally, planimetry did not accurately **measure** the change in **lung volume** from FRC to TLC within individuals. The authors concluded that radiographic planimetry is not a robust enough **technique** to replace other well-established **techniques** for **measuring lung volume** . Moreover, the exposure to radiation associated with this approach limits the frequency of repeated **measurements** . Nevertheless, radiography has proved to be very useful in certain situations, such as large epidemiologic surveys in which chest radiographs may be part of the screening **process** and standard PFTs may not be available.

While we are unaware of any published studies that report the extent of utilization for each **method** , we suspect that gas dilution is perhaps the most widely used **method** for **measuring** TLC. Among the **methods** available, however, there is no one preferred **method** . Each setting should be individualized and the choice of the **method** should be based on factors such as the purpose of the test, the patient population, feasibility, and cost. Furthermore, a fundamental understanding of the advantages and disadvantages of each **method** (Table 3) is necessary for accurate interpretation and use of the **measurements** from these **methods** .

(TABULAR DATA 3 NOT REPRODUCIBLE IN ASCII)

In summary, our study demonstrates that in normal subjects and in patients with mild airways obstruction, the single-breath and multiple-breath **helium** dilution **techniques** yield similar **measurements** for TLC. However, in patients with moderate to severe obstructive lung disease, single-breath **helium** dilution **systematically** underestimates the multiple-breath TLC. **Adjusting** the single-breath **measurement** in these patients improves the level of agreement between the two **methods** , thus increasing the potential use of this relatively simple and rapid **technique** . The findings from our study extend previous work in several ways. First, to our knowledge this is the largest study to date comparing the single-breath and multiple-breath **helium** dilution **techniques** . Second, the inclusion of a heterogeneous group of patients in the initial comparison of the two **techniques** and in the validation of the model at a different pulmonary function laboratory increases the generalizability of our results. Third, the simple linear **adjustment** proposed for patients with moderate to severe obstruction is easy to apply both prospectively and to previously collected data sets. While we do not propose that single-breath **helium** dilution replace the multiple-breath **technique** , we do believe that the approach presented here has value in field or epidemiologic studies in which other **methods** are not feasible.

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(\*) From the Division of Pulmonary and Critical Care Medicine, Johns ...

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**Single-breath, room-air method for measuring closing volume (phase 4)  
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**Single-breath, room-air method for measuring closing volume (phase 4)  
in the normal human lung.**

TEXT:

The purpose of this study was to **evaluate** a new **method** to **measure** closing volume (CV). This new **method** does not require oxygen or **inert gases** to be inhaled to obtain the onset of phase 4. Because there are regional differences in the **concentrations** of the resident alveolar gases [(O.sub.2), [ CO . sub . 2 ], and [ N . sub . 2 ]), there should be an abrupt change in the **concentration** of these gases as the terminal portion of a prolonged expired vital capacity (VC) that...

...inspired room air from residual volume (to mimic the maneuver of the standard single breath [ N . sub . 2 ] ([SBN.sub.2]) washout test) to total **lung capacity**. During the expiration (flow constant at 250 [ml.s.sup.-1]) following a 10-s breath hold at total **lung capacity**, the exhaled gas was analyzed with a mass spectrometer for fractions of [O.sub.2], [ CO . sub . 2 ], and [ N . sub . 2 ]. Although the onset of phase 4 can be shown as the change in **concentration** of any of the three alveolar resident gases, oxygen was selected because (1) it demonstrates a greater apex to base **concentration** gradient than that found with [ CO . sub . 2 ] and [ N . sub . 2 ], and (2) a clear identification of the onset of phase 4 (minimum value of [O.sub.2] fraction). With this **method**, the mean [+ or -] SEM of CV was 16.8 [+ or -] 1.52 **percent** (CV x 100/VC). No significant difference was found among the room air **method**, [SBN.sub.2] **method**, and the **helium bolus technique**.

Distribution of **ventilation** in normal human lungs is uneven. The description by Milic-Emili et al[1] of...

...Their model explains the earlier observation by Fowler[2] of an increase in the expired **nitrogen concentration** in the terminal portion of the expired volume of the vital capacity (VC). Dollfuss et al[3] labeled this abrupt increase in gas **concentration** as phase 4. Because it was postulated that this abrupt increase was due to a...

...at residual volume (RV). Therefore, the detection of phase 4 is a requirement for the **measurement** of CV. In order to obtain phase 4, a gas **concentration** gradient must exist between the dependent and nondependent regions of the lung.[5] In the upright lung, these regions correspond to the basal and apical regions, respectively.

The standard **method** to **measure** CV is the single-breath **nitrogen** washout test ([SBN.sub.2]). However, because of the importance of a reliable **measurement** of CV, investigators have introduced other **methods** to better identify the onset of phase 4, such as **inhalation** of inert

gases. The **helium** [6,7] and argon[8] bolus **techniques** are the two most popular tests, but xenon-133[3,5] and other **inert gases** have also been applied. The [SBN.sub.2] test requires an inspiration of 100 **percent** [O.sub.2] from RV to total **lung capacity** (TLC).[9] The **inert gas bolus techniques** require an **inhalation** of a bolus of the representative **tracer gas** at RV, followed by inspiration of room air to TLC. The use of a **method for measuring CV** that would not require **breathing 100 percent** [O.sub.2] or an **inert gas** would provide an alternative **procedure**.

According to the lung model of West,[10] there is a 43 mm Hg difference...

...of the upright lung. The corresponding differences for [PCO.sub.2] and [PN.sub.2] **amount** to only 14 and 29 mm Hg, respectively. We reasoned that the phenomena of phase...

...longer contributes to the expirate during a prolonged expiration to RV. This room air CV **method** was compared with the [SBN.sub.2] and **helium bolus methods**.

#### MATERIAL AND METHODS

Nine normal, healthy male volunteers, 30 to 65 years of age, whose general physical characteristics...

...corrected for time delay of 0.2 s between expired gas flows and the gas **concentration** outputs. Expired gas was sampled at the lips through a needle located in the mouthpiece 1 cm from the subject's incisors. Both inspiratory and expiratory gas flow were **measured** with a pneumotachograph (Fleisch, Rockford, Ill) that was inserted between a four-way valve and...

...the four-way valve and was used as a reservoir for the foreign gases, 100 **percent helium** (bolus **technique**), or 100 **percent** [O.sub.2] ([SBN.sub.2] test). The voltage output from the mass spectrometer and the pneumotachograph were sampled at 50 Hz by an analog-to-digital converter. The gas **concentrations** ([O.sub.2], [CO . sub . 2 ], [N . sub . 2 ], and **helium**) and the flow signals were sampled and **processed** on line by an eight-channel acquisition **system** (MacLab, New Haven, Conn) and a computer (Apple Macintosh IIX, Cupertino, Calif).

#### Room-Air Method for Measuring CV

Subjects initially performed four or five normal tidal breaths with room air. Subsequently they...

...The expired flow rate was kept constant with the aid of a visual flowmeter. Fractional **concentrations** of exhaled [CO . sub . 2 ], [O.sub.2], and [N . sub . 2 ], and the expired gas flow were recorded. The lowest value of fraction of [O.sub.2]...

...3 and beginning of phase 4. The onset of phase 4 was then used to **measure** the closing volume.

#### [SBN.sub.2] and the Helium Bolus Tests for Measuring CV

After four or five normal breaths of room air, the same subjects studied above...

...spirometer via a mouthpiece and the four-way valve. Each subject then either inspired 100 **percent** [O.sub.2] to TLC or a bolus of (100 **percent helium**) 250 ml of pure **helium** at the beginning of the breath, ie, from RV followed by **inhalation** of room air to TLC. In both experiments, the exhalation proceeded at a rate of approximately 250 ml.[s.sub.-1] from TLC to RV. For the [SBN.sub.2] **method**, CV was **measured** following the recommendations of the National Heart, Lung, and Blood Institute guidelines.[9] In brief...

...by visual inspection, then the first convincing departure from this line was taken as the **indicator** of the onset of phase 4. A similar **technique** was applied to the **helium bolus method**.

Closing volume was **measured** as the expired volume beginning at the onset of phase 4 and ending at RV. A minimum of three tracings were obtained for each subject and for each **method**. In all three **methods**, 10 min were allowed between trials to wash out the inhaled gases. All tests were...

...This study employed a within-subjects design in order to examine the equivalence of three **methods** for **determining** CV. Multivariate analysis of variance (using Proc GLM of the SAS statistic package)[11] was...

...type. Significance level for statistical tests was set at 0.05.

#### RESULTS

The expired gas **concentrations** corresponding to each of the three **methods** --room air, [SBN.sub.2] and **helium** --in a representative subject, have been compiled and are shown in Figure 1. As expected, the gas **concentrations** in phase 1 were identical to those in the inspired gases. A sudden change in the fractional **concentrations** marked the beginning of phase 2. In this phase, all three gas fractions ([FO.sub...

...and FHe) produced sigmoidal-shaped curves. While in the [SBN.sub.2] washout test and **helium bolus technique** there is an increase in the fractional gas **concentrations** ([FN.sub.2] and FHe, respectively), the opposite was observed with the [FO.sub.2] (room air **method**), a decrease in the fractional **concentration**. All gases show the alveolar gas plateau, phase 3. The slope of this phase for...

...inspection, without the drawing of the best fit line, was required by the observer to **determine** the phase 3-4 intercept. However, because the slopes of phases 3 and 4 were positive, in both the [N . sub . 2] and **helium methods**, the drawing of the best fit line became essential especially when the slopes of the...

...3 and 4 are only separated by a few units. Because the [O.sub.2] **concentration** fell during phase 3 and then rose, changing the sign of the slope created a minimum gas fraction value, which allowed the onset of phase 4 to be **determined** more easily and without the above problem.

The CV mean [+ or -] SD of each subject read by three different observers for all three **methods** are presented in Table 2. No significant differences were found among **methods**, observers, or interaction between observer and **method** (Table 3).

#### DISCUSSION

As early as the turn of the century, investigators have suggested that the **inhalation** of atmospheric air could not be considered feasible to elucidate questions concerning the mixing of inspired gases with the resident alveolar gases.[12] Therefore, boli of **inert gases**, such as hydrogen, **helium**, and argon, have been used to study the distribution of inspired gases. Contrary to accepted...

...study the distribution of inspired gases. Due to the apex to base difference in the **concentrations** of the [TABULAR DATA OMITTED]

resident alveolar gases, we reasoned that the phenomena of phase 4 could be demonstrated. Flores[13] demonstrated that during room-air **breathing**, the onset of phase 4 can be identified during a prolonged expiration to RV with...

...the present study show no significant difference in the onset of phase 4

by the **inhalation** of room air, oxygen, or **helium** .

The rise in [O.sub.2] and the fall in [ **CO . sub . 2** ] at the end of a prolonged expiration, now known as phase 4, were observed more...

...of phase 4, a rational approach was designed to employ alveolar gases ([O.sub.2], [ **CO . sub . 2** ] and [ **N . sub . 2** ]) as **tracers** to **measure** CV. The following lung model helps to clarify the rationale employed.

#### Model Used for the Room-Air **Method**

The present model is constructed by a combination of three models found in the literature. [1,10,18] This model takes into account the regional [O.sub.2] and [ **CO . sub . 2** ] gas exchange in the lung at steady state conditions. Alveolar [ **N . sub . 2** ] **concentration** is set by the other two gases, thus: [FAN.sub.2] = 1-([FAO.sub.2] + [FACO.sub.2]). The alveolar gas **concentration** values for [O.sub.2] and [ **CO . sub . 2** ] at steady-state conditions are **determined** from a balance between

Table 3--Multivariate Test Results for Observer and Test Differences  
Hotelling...

...4,5    1.4173    0.35

(\*1) df = degrees of freedom

[TABULAR DATA OMITTED]

alveolar **ventilation** and pulmonary perfusion (VA/Q). The alveolar [Po.sub.2] and [Pco.sub.2] at...

...values were altered first, by the gas inspired, and second, by [O.sub.2] and [ **CO . sub . 2** ] gas exchange. Room air inspiration was simulated from RV and FRC, and gas exchange 70 exchange. These **calculations** are described in the appendix.

#### Room-Air **Method** vs Other **Methods**

The maneuver of exhaling first to RV and then inhaling room air to TLC was...

...mimic the same maneuvering that is performed with the [SBN.sub.2] washout test and **helium** bolus **technique** . Therefore, comparable maneuvers were analyzed.

Because expired alveolar [ **N . sub . 2** ] **concentration** changes very little during normal expiration, a volume of [O.sub.2] corresponding to a VC is inhaled to dilute the resident alveolar [ **N . sub . 2** ] and magnify the apex to base **concentration** differences. Using the model described above, the **calculated** apex to base [ **N . sub . 2** ] **concentration** gradient after a VC inspiration of oxygen ([SBN.sub.2] test) has been **calculated** (Table 5). Unfortunately, with the [SBN.sub.2] washout test not all subjects show a...

...phase 4, [19] probably due to variations in the magnitude of the apex to base [ **N . sub . 2** ] gradient. Consequently, investigators have developed other **methods** to identify the [TABULAR DATA OMITTED]

onset of phase 4. Thus, the **inert gas technique** was derived. The [SBN.sub.2] washout test and the **helium** bolus **technique** are now the two most practiced **methods** . Herein, we are demonstrating an alternative **method** that does not require the **inhalation** of 100 percent [O.sub.2] or an **inert gas** . We **evaluated** this new **method** for **measuring** CV by comparing it with the standard [SBN.sub.2] washout test and the **helium** bolus **technique** . The multivariate analysis of variance showed no significant difference among the three **methods** (Table 3). Due to large variations in the size of **lung volumes** , the **amount** of inhaled **tracer** gas from residual volume will produce a small or large **concentration** difference between the apex and the base of the lungs. From the work of Laviolette...

...experiments (unpublished), the magnitude of the slope for phase 4 is directly dependent on the **amount** of trace gas inhaled. A lesser rise of phase 4 (slope) in [ **N . sub . 2** ] when the [SBN.sub.2] test is used as compared with a steeper and better resolution of the inflection point between phases 3 and 4 using the bolus **technique** has been predicted[21] by **estimating** the changes in the relative **concentrations** of regional alveolar gases to the predicted alveolar **concentrations** of phase 3. This difference is evident in Figure 1. However, the **estimates** of CVs are not different among **methods** (Table 2). This is also true in the model of Kaneko et al[21] (see their Fig 5). Other investigators also failed to show a difference in CV **determinations** between the **helium** bolus **technique** and the [SBN.sub.2] washout test.[6,7] The variability observed among subjects is...

...the onset of phase 4 can be easily identified by using the new room-air **method** while exhibiting no significant differences between the two most common **methods** ([SBN.sub.2] and **helium** bolus). Furthermore, the room-air **method** appears to be the simplest of all three modalities. First, no foreign gas (100 **percent** [O.sub.2] or **inert gases**) needs to be inhaled. Second, the beginning of phase 4 is self- **determined** when resident [O.sub.2] is analyzed; thus, the need to draw a best fit line through phase 3 of the gas curve is **eliminated**. This study was conducted in healthy subjects; the **assessment** of our **method** in subjects with pulmonary-impaired disease still needs to be addressed.

#### APPENDIX

The apex and...

...regional lung model[18] are herein used to quantitate the alveolar [O.sub.2] and [ **CO . sub . 2** ] changes that took place upon inspiration (from RV or FRC) and the changes that occurred with gas exchange. Briefly, this model[18] consists of seven regions with similar **lung volumes** at TLC (each has 1/7 of TLC). Only the apex and base regions are considered for these **calculations**. At RV they have 32.7 **percent** and 7.6 **percent** of regional TLC for the apex and base, respectively. Each region inflates/deflates in a...

...sub.b] =  $0.23X + [X.\text{sup.2}] - [0.23X.\text{sup.3}]$ ), where X is the **lung volume** as a fraction of TLC. [V.sub.a] and [V.sub.b] are regional volumes as fractions of regional TLC. The alveolar [O.sub.2] and [ **CO . sub . 2** ] values at rest for the apex and base regions are taken from the lung model ...

...alveolar gas fractions and the RV, as well as the FRC of the subject, the **amount** of [O.sub.2] and [ **CO . sub . 2** ] can be **calculated**. Adding the **amount** of [O.sub.2] inspired (no [ **CO . sub . 2** ] is inhaled with room air), the alveolar [O.sub.2] and [ **CO . sub . 2** ] fraction at RV or FRC level can be **calculated**. The resulting **calculations** for alveolar [O.sub.2] and [ **CO . sub . 2** ] fractions following the inspiration of room air (VC = 6.1 L, at sea level) after...

...seen, there is a substantial gain of alveolar oxygen and a significant dilution of alveolar [ **CO . sub . 2** ]. The dilution for [ **CO . sub . 2** ] at the base is more marked. If we simulate a [ **CO . sub . 2** ] expirogram with these alveolar gases, an end-tidal [ **CO . sub . 2** ] of 6.6 mm Hg, or 0.0092 is obtained. This is at variance with experimental findings (end-tidal [ **CO . sub . 2** ] of 30 mm Hg or 0.0421 at 0 s breath holding) whereby the effect of breath holding on end-tidal [ **CO . sub . 2** ] was studied.[23] The difference between the model and the experiments suggests that physiologically a significant **amount** of [O.sub.2] and [ **CO . sub . 2** ] was exchanged at the alveolar-capillary level during the inspiratory

maneuver, due to an enlarged mixed venous to alveolar [  $\text{CO} \cdot \text{sub} \cdot 2$  ] gradient.

Secondly, in order to **calculate** the effect of gas exchange with the model, the ratio of [  $\text{CO} \cdot \text{sub} \cdot 2$  ] to [O.sub.2] of the differences between the alveolar gases at FRC and those after inspiration allow us to **calculate** the gas exchange ratio in each region. A total pulmonary blood flow of 5.784...

...the VC maneuver. Taking these conditions into consideration and the standard [O.sub.2] and [  $\text{CO} \cdot \text{sub} \cdot 2$  ] dissociation curves, the [O.sub.2] and the [  $\text{CO} \cdot \text{sub} \cdot 2$  ] fluxes can be **calculated**. Thus, assuming a steady-state gas exchange, the time required for the alveolar gases to return to the resting values can be **calculated**. The results (Table 4) show that this **process** takes 70 s.

Thirdly, if a volume of room air is inhaled from FRC to...

...observed (Table 4, inspiration from FRC), but to a lesser degree. Therefore, if normal tidal breathing is maintained, the expected changes will be even less, perhaps closer to the resting values...

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...DESCRIPTORS: **Lung** **volume** **measurements** --...

... **Respiration** --...

... **Measurement**

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**Hypoxic pulmonary vasoconstriction and gas exchange during exercise in chronic obstructive pulmonary disease.**

Agusti, Alvar G.N.; Barbera, Joan A.; Roca, Josep; Wagner, Peter D.;  
Guitart, Raimon; Rodriguez-Roisin, Robert  
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TEXT:

...this drug lowers pulmonary hypertension, but the effects of this lower pulmonary vascular tone on **ventilation**-perfusion (Va/Q) relationships are still poorly understood. To analyze them, we **determined** the Va/Q distributions in eight patients with stable COPD ([FEV.sub. 1], 36 **percent** of predicted) at rest and during exercise (60 **percent** [Vo.sub.2max]), before and after nifedipine (20 mg sublingually). Nifedipine shifted to the right...

...in patients with COPD, as it is shown here, is due to improvement in the **ventilation** distribution. Interestingly, this Va/Q improvement was not paralleled by a significant decrease of P(A-a) [O.sub.2]. This apparent paradox could be explained by 20 **percent** of the actual P(A-a) [O.sub.2], during exercise due to diffusion limitation, as **assessed** through the **inert gas** approach. Taken all together, these results help to better understand the mechanisms that govern pulmonary...

HPV = hypoxic pulmonary vasoconstriction; relationship = **ventilation**-perfusion relationships; shunt ( **inert gases** ) = **percent** of Qt to lung units with Va/Q = ratios <0.005; low Va/Q = **percent** of Qt to lung units with Va/Q ratios <0.1. ( **excluding** shunt); high Va/Q = **percent** of Ve to lung units with Va/Q ratios 10 to 100; dead space= **percent** of Ve to lung units with Va/Q ratios >100...

...at the mean of the blood flow distribution; V = ratio at the mean of the **ventilation** distribution Logsd Q=dispersion (SD) of the blood flow distribution on a log scale; Logsd V = dispersion (SD) of the **ventilation** distribution on a log scale, DISP R-E\* = overall degree of Va/Q...

...mismatching directly obtained from the raw **inert gas** data; Ppa = pulmonary artery pressure; PFT = pulmonary function test; Dco = carbon monoxide diffusing **capacity** ; Qt, cardiac output; Pw = **pulmonary** capillary wedge pressure; TPVR = total pulmonary vascular resistance; RVSWI = right ventricular stroke work index; f = **respiratory** rate; R = **respiratory** ; Qs/Qt = venous admixture; Vd/Vt = dead space tidal volume ratio; BE = base excess

In...

...COPD) studied at rest, nifedipine releases hypoxic pulmonary vasoconstriction (HPV), diverts blood flow to poorly **ventilated** lung units, and worsens gas exchange.[1] During exercise, release of HPV in COPD by...

...of pulmonary hypertension.[2-4] However, the effects of this lower pulmonary vascular tone on **ventilation**-perfusion (Va/Q) relationships under exercise conditions are still poorly understood. This investigation



was aimed...

...hypoxic vasoconstriction in modulating pulmonary gas exchange during exercise in COPD. We used the multiple **inert gas elimination technique** [5,6] **determine** the  $V_a/Q$  distributions of eight patients with COPD at rest and during exercise, before...

...those with end-stage vascular disease, who presumably have more irreversible structural damage. [7,8]

#### **Methods**

##### **Patients...**

...nonreversible chronic airflow limitation ( $[FEV_{sub.1}]$ , 1.15 [+ or -] 0.12 L [36 [+ or -] **percent** predicted]) were selected from the outpatient clinic of our institution. None of them had clinical...

...heart disease. None of them was receiving oxygen therapy at home. Pulmonary function test (PFT) **evaluation** included **measurement** of static and dynamic; **lung volumes** (HP-47804A **Pulmonary System** Desk; Hewlett-Packard, Palo Alto, Calif), plethysmographic functional residual capacity and airway resistance (Body test...

...corrected for hemoglobin. [9] Predicted values for PFT were from our own laboratory. [10,11]

##### **Procedures**

A transvenous balloon-tipped catheter (Swan-Ganz 7F, Edwards Laboratories, Santa Ana, Calif) was placed...

...polyethylene catheter (Seldicath, Plastimed, France) was inserted in the radial artery. Cardiac output ( $Q_t$ ) was **determined** by the thermodilution **technique** (9520A, Edwards laboratories, Santa Ana, Calif). Intravascular pressures were continuously monitored (HP-7754 B) using HP-1290 A transducers and were read at end expiration over three **respiratory** cycles (the external zero reference level was positioned at midchest). During exercise, the pronounced pleural...

...de the **measurement** of pulmonary capillary wedge pressure (Pw) difficult. Therefore, we elected to report Pw only at rest and to **calculate** total pulmonary vascular resistance (TPVR) as mean Ppa divided by  $Q_t$ . 4 Right ventricular stroke...

...was ( $yr (L.[min.sup.-1]/body surface area ([m.sup.2).sup.2]$ )

Minute **ventilation** ( $V_e$ ) and **respiratory** rate ( $f$ ) were recorded minute by minute using a calibrated Wright spirometer. Low dead space...

...Mo) or during exercise (E. Jaeger, Wurzburg, FRG). Oxygen uptake ( $[V_{O_{sub.2}}]_{to}$ ) and **carbon dioxide** output ( $[V_{CO_{sub.2}}]$ ) were **calculated** from mixed expired fractions of  $[O_{sub.2}]$  and  $[CO_{sub.2}]$  (Multi-gas MS2, Medishield, Ohmeda:BOC UK), respectively, and the **respiratory** quotient (R) as  $[V_{CO_{sub.2}}]/[V_{O_{sub.2}}]$   $[P_{O_{sub.2}}]$ ,  $[P_{CO_{sub.2}}]$ ...

...were analyzed in duplicate (IL 1302 pH blood gas analyzer; Instrumentation Laboratories, Milan, Italy). Hemoglobin **concentration** was **measured** (OSM-2 Hemo-oximeter, Radiometer, Copenhagen, Denmark) and oxygen saturation was computed through Kelman's...

... $O_{sub.2}$  venous admixture ( $Q_s/Q_t$ ), dead space-tidal volume ratio ( $V_d/V_t$ , and **systemic**  $[O_{sub.2}]$  delivery were **calculated** using standard formulas. [12]

The  $V_a/Q$  distributions were **estimated** by the multiple **inert gas elimination technique** . [5,6] Particular features of its set-up in our

laboratory have been reported elsewhere.[12] Briefly, after infusing a 5 percent dextrose solution of six inert gases ([SF . sub . 6 ,] ethane, cyclopropane, enflurane, ether, and acetone) through a peripheral vein for about 30 minutes at...

...samples of heparinized arterial and mixed venous blood and mixed expired gas were simultaneously withdrawn. Inert gas concentrations in mixed expired samples and the gas phase of equilibrated arterial and mixed venous samples were measured by gas chromatography (Hewlett-Packard 5880A). Solubilities of inert gases were measured for each patient and the  $V_a/Q$  distributions were estimated from the inert gas data using a least-square fit to the data by a multicompartmental model with enforced smoothing in the usual manner.[13] We defined shunt as the percentage of  $Q_t$  perfusing essentially unventilated alveoli ( $V_a/Q < 0.005$ ), low and high  $V_a/Q$ ...

...0.005 and 0.1, and 10 and 100, respectively, and dead space as the percentage of  $V_e$  to lung units with  $V_a/Q$  ratios higher than 100. The latter includes...

...unperfused alveoli, and instrument dead space. The position of the pulmonary blood flow ( $Q$ ) and ventilation ( $V$ ) distributions is described by the  $V_a/Q$  ratio at their mean ( $Q$ ,  $V$ , respectively)...

...standard deviation on a log scale ([log.sub.sd]  $Q$ , [Log.sub.sd.]  $V$ ). The inert gas results are also reported as the dispersion directly obtained from retention ( $R$ ) minus excretion ( $E$ ) (corrected for the acetone excretion,  $E^*$ ) of each inert gas ( $DISP\ R-E^*$ ), which is an index of the overall amount of  $V_a/Q$  mismatching.[14]

#### Protocol

The protocol was approved by the Hospital Clinic-Facultat...

...vasoactive or bronchoactive effects. After the patient had fasted overnight and without premedication, pulmonary and systemic arterial catheterization were performed. Forty-five minutes after starting the inert gas infusion, measurements of pulmonary and systemic hemodynamic variables and respiratory and inert gas exchange parameters were taken at rest. Then, exercise was begun on a cycle ergometer (E. Jaeger) at a power output ( $33 [+ \text{ or } -] 8\text{ W}$ ) equivalent to 50 to 60 percent of their maximal tolerated work load (which had been quantified on a previous day), and a second set of hemodynamic and gas exchange measurements was obtained approximately ten minutes later. The patients were allowed to rest for 15 to 30 minutes until pulmonary and systemic hemodynamic variables and respiratory gas exchange parameters had returned to resting conditions. Nifedipine (20 mg) was then given sublingually, and resting and exercise measurements were repeated as before (at 45 minutes and 1 h after nifedipine, respectively). All measurements were taken in a semirecumbent position. A steady state condition (as defined by variations of less than  $[+ \text{ or } -] 5\text{ percent}$  in heart rate and minute ventilation and of less than  $[+ \text{ or } -] 0.1\text{ percent}$  in  $[FeO.sub.2]$  and  $[FeCO.sub.2]$ ) was monitored in each of the steps...

...the present protocol (rest and exercise with and without nifedipine) by continuously monitoring electrocardiogram, minute ventilation, respiratory rate, and mixed expired  $[O.sub.2]$  and  $[CO . sub . 2 .]$  The hemodynamic measurements were obtained before and after blood sampling for respiratory and inert gas analysis. Given that there were no significant differences between these two hemodynamic measurements, only values obtained after blood sampling are reported.

#### Safety Measures

Our primary concern at all times during the study was the safety of the patient. Consequently, improvement in monitoring **procedures** included a continuous graphic recording of **systemic** and pulmonary arterial pressures as well as continuous electrocardiographic (HP-7830A) and ear oximetry (Biox...

...of them did. Three physicians were present at all times, with one directing his attention **exclusively** to the patient.

#### Statistical Analysis

An analysis of variance for repeated **measures** (MANOVA, SPSS) was used to compare **measurements** at rest and during exercise, before and after nifedipine. Interaction between exercise and nifedipine was...Hg) and mild increases in both the  $P(A-a)[O_{2\text{sub}}]$  and the **percentage** of venous admixture ( $Q_s/Q_t$ , 10 [+ or -] 1 **percent**). None of the patients had  $[CO_{2\text{sub}}]$  retention, but all had  $V_d/V_t$  values higher than 40 **percent**. The **inert gas** data showed only small **amounts** of shunt and/or blood flow to lung units with  $V_a/Q$  ratios lower than 0.1 (less than 1 **percent** of  $Q_t$ , each). Seven of the eight patients showed a broad unimodal blood flow distribution...

...shunt; patient 7 showed a bimodal blood flow distribution. Only patient 5 had a noticeable **amount** of shunt (2.6 **percent** of  $Q_t$ ). Four patients (patients 1, 3, 5, and 7) had bimodal **ventilation** distributions with a substantial **percentage** of  $V_e$  distributed to high  $V_a/Q$  areas (10 to 100). The dispersion of the blood flow and **ventilation** distributions ( $[Log_{\text{sub}}sd] Q$  and  $[Log_{\text{sub}}sd] V$ , respectively) (normal range, 0.3 to 0.6) and the overall **amount** of  $V_a/Q$  mismatching **estimated** from raw retention and excretion values ( $DISP R-E^*$ ) were moderate to severely increased with...

... $p < 0.05$ ), and  $Q_s/Q_t$  was higher (10 [+ or -] 1 to 15 [+ or -] 2 **percent**,  $p < 0.05$ ). Because of the above-mentioned increase in  $Q_t [O_{2\text{sub}}]$  delivery ...

...992 [+ or -] 85 to 1,228 [+ or -] 97 ml. $[min_{\text{sub}}-1]$ ,  $p < 0.005$ ).

**Ventilation** -perfusion mismatching increased after nifedipine (higher  $DISP R-E^*$ ,  $p < 0.001$ ) Specifically, the blood...

...strongly suggest release of HPV.[1] Despite the increase observed in the dispersion of the **ventilation**, distribution ( $[Log_{\text{sub}}sd] V$ ) was not modified by nifedipine. However, this increase in  $V_e$ ...

...vs Rest Before Nifedipine)

Exercise  $[V_{O_{2\text{sub}}}]$  (872 ml/min) averaged 53 [+ or -] 5 **percent** of maximal predicted.<sup>16</sup> This represented a substantial level of exercise for these patients, as...

...not change (28 to 31 mm Hg). The  $V_d/V_t$  fell from 50 to 42 **percent** ( $p < 0.001$ ). Exercise reduced  $V_a/Q$  mismatching as **estimated** either by the significant decreases in  $[Log_{\text{sub}}sd] Q$  and  $[Log_{\text{sub}}sd] V$  or...

... $O_{2\text{sub}}$ ] transfer from alveoli to the end-capillary blood is evident as a **systematically** higher predicted than **measured**  $[PaO_{2\text{sub}}]$ .<sup>[6]</sup> At rest, no significant difference was noticed between predicted and **measured**  $[PaO_{2\text{sub}}]$ . However, during exercise, predicted  $[PO_{2\text{sub}}]$  (74 [+ or -] 5 mm Hg) was **systematically** higher than **measured**  $[PaO_{2\text{sub}}]$  (68 [+ or -] 4 mm Hg,  $p < 0.002$ ). In absolute terms, this difference was small (6 [+ or -] 1 mm Hg) and accounted for 20 **percent** of the actual  $P(A-a)[O_{2\text{sub}}]$ . This observation suggests that pulmonary  $[O_{2\text{sub}}]$ ...

...did not change after giving the drug. Finally, it is of note that predicted and **measured**  $[PaO_{2\text{sub}}]$  values during exercise after

nifedipine fell along the same direction as during...during exercise with nifedipine, it was higher after than before giving the drug. Accordingly, the **percentage** of **ventilation** distributed to high Va/Q areas (10 to 100) increased almost twofold during exercise after nifedipine (3.7 to 6.2 **percent** ), but differences failed to reach statistical significance. Overall, there was more VA/Q mismatching during...

... $p < 0.001$ ). The perfusion distribution was shifted to the left (lower Q) and the **ventilation** distribution was shifted to the right (higher V). The higher [Log.sub.sd] Q during...

...to distribute blood flow during exercise in a more efficient manner. The dispersion of the **ventilation** distribution ([Log.sub.sd] V) during exercise was not modified by nifedipine.

A synergistic effect...

...the latter has a small functional effect since, even after nifedipine, exercise reduced the overall **amount** of Va/Q mismatch. This observation suggests that the role of HPV in modulating gas...

...of the Va/Q improvement seen under these conditions is due to improvement in the **ventilation** distribution. To clarify the more relevant aspects of this investigation, the effects of exercise on...

...22] Wagner et Al [17,18] and Dantzker and D'Alonzo [22] used the multiple **inert gas elimination technique** to study patients with COPD during exercise. Even though Va/Q inequality did not change...

...the reduction of Qs/Qt. [19] However, since the latter investigation used conventional gas exchange **measurements**, the authors could not separate the precise role of Va/Q mismatching, shunt, and [O...

...Dantzker and D'Alonzo [22] vs 1.5 L [in our patients]) together with more [CO . sub . 2 ] retention at rest (56 vs 39 mm Hg, respectively). Thus, we suggest that the less the alveolar **ventilation** (lower [Log.sub.sd] V) and the pulmonary blood flow (lower [Log.sub.sd] Q...

...2] did not change. At first glance, this suggests that exercise did not modify the **efficiency** of the lung as a **gas exchanger**. However, as it has been already pointed out, the **inert gas elimination technique** showed that the Va/Q distributions definitely improved during exercise. The apparent paradox of a...

...without any noticeable change in P(A-a) [O.sub.2] is explained by 20 **percent** of the P(A-a) [O.sub.2] due to diffusion limitation, as suggested by the higher predicted than **measured** [PaO.sub.2] during exercise ( $p < 0.002$ ). [6] This would then limit the expected...

...2] electrodes is checked daily with tonometered blood, and reported [Po.sub.2] values are **systematically** corrected for body temperature [6] which, in the present study, was obtained through the thermistor...

...not seen at rest. Moreover, during exercise after nifedipine (1 h after the first exercise **measurements** were taken), we observed a similar trend ( $p = 0.09$ ). Thus, under these circumstances, a...  
...this observation.

Role of HPV During Exercise

At rest, nifedipine diverted blood flow to poorly **ventilated** lung units. This observation strongly suggests release of HPV and is in keeping with previous...

...effect in modulating the gas exchange response to exercise in COPD. Note that the overall **amount** of Va/Q mismatching (DISP R-E\*) improved with exercise even after the release of...

...most of the Va/Q improvement seen during exercise is due to improvement of the **ventilation** distribution.

[TABULAR DATA OMITTED]

For example, the increase in the end-inspiratory volume that follows exercise may have facilitated a better **ventilation** of airways that were partially closed at rest. We cannot **exclude** that nifedipine has some effect on the bronchomotor tone. However, given that nifedipine has no...

...in our patients. On the other hand, the potential effects of the slight changes in [ CO . **sub** . 2 ] during exercise on bronchomotor or vascular tone, although presumably negligible, cannot be **quantified** by design.

To summarize, our study shows that exercise can improve Va/Q mismatching in...

...suggests that most of this improvement depends on a more homogeneous distribution of the inspired **ventilation** and that hypoxic pulmonary vasoconstriction probably plays a minor role in the modulation of such...

...pulmonary vasoconstriction by nifedipine interferes with the ability of the pulmonary circulation to distribute blood **flow** more **efficiently** and worsens pulmonary **gas exchange**, not only at rest but also during exercise. Finally, this investigation highlights a limitation in...

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25026 L5

182971 L7

L19 178 L1 AND L2 AND (L4 OR L5 OR L6 OR L7 OR L8 OR L9)

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OR L18)

=> s l20 and (method or methods or tracer? or marker? or l3)

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60113 TRACER?

178374 MARKER?

L21 20 L20 AND (METHOD OR METHODS OR TRACER? OR MARKER? OR L3)

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L24 ANSWER 68 OF 100 HCAPLUS COPYRIGHT 2004 ACS on STN

ACCESSION NUMBER: 1981:61148 HCAPLUS

DOCUMENT NUMBER: 94:61148

TITLE: Autoanalyzer for lung diffusion  
capacity determination

PATENT ASSIGNEE(S): Hitachi, Ltd., Japan; Yokoyama, Tetsuo.

SOURCE: Jpn. Tokkyo Koho, 12 pp.

CODEN: JAXXAD

DOCUMENT TYPE: Patent

LANGUAGE: Japanese

FAMILY ACC. NUM. COUNT: 1

PATENT INFORMATION:

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
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JP 55040812	B4	19801020	JP 1973-43180	19730418 <--
PRIORITY APPLN. INFO.:			JP 1973-43180	19730418
AB	An automated analyzer with mass spectroscopic arrangement is presented for the determination of lung diffusion capacity and gas exchange rate. A mixture containing He, N, CO and O is inhaled by a test subject and the exhaled air containing these gases and CO2 is introduced into the analyzer for anal. The analyzer contains a device for the removal of CO2 prior to anal., and an automated device for calculating the lung diffusion capacity on the basis of the ratio of (He concentration in exhaled air/He concentration in inhaled air) + CO concentration in inhaled air : CO concentration in exhaled air.			

L24 ANSWER 74 OF 100 HCAPLUS COPYRIGHT 2004 ACS on STN

ACCESSION NUMBER: 1977:14571 HCAPLUS

DOCUMENT NUMBER: 86:14571

TITLE: Pulmonary gas exchange after replacement of air  
**nitrogen by other inert  
gases**

AUTHOR(S): Worth, H.; Takahashi, H.; Piiper, J.

CORPORATE SOURCE: Abt. Physiol., Max-Planck-Inst. Exp. Med., Goettingen,  
Fed. Rep. Ger.

SOURCE: Pneumonologie (1976), Suppl., 213-15

CODEN: PNMGAU; ISSN: 0033-4073

DOCUMENT TYPE: Journal

LANGUAGE: German

AB The influence of phys. properties of the **breathing** medium on alveolar gas exchange was studied measuring alveolar-arterial partial pressure differences ( $\delta p$ ) for O and CO<sub>2</sub> in artificially **ventilated, anesthetized** dogs, replacing air N by **He**, Ar, or **SF<sub>6</sub>**. In both hypoxia and normoxia, the  $\delta pO_2$  decreased in the sequence **He-O<sub>2</sub>** > **N<sub>2</sub>-O<sub>2</sub>** > Ar-O<sub>2</sub> > **SF<sub>6</sub>-O<sub>2</sub>**, whereas  $\delta pCO_2$  remained practically unchanged. Addnl. measurements of **pulmonary** diffusing **capacity** for CO (DCO) using the single breath technique revealed no significant differences among the 4 gas mixts. used. These results were interpreted in terms of the possible roles of diffusion limitation (stratification), Taylor dispersion, and viscosity-dependent **ventilation-perfusion inhomogeneties**.

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		OR INSUFFLAT?
S4	1	IC=(A61B? OR A61M? OR G01F?)
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**Millivolt-scale DC shifts in the human scalp EEG: Evidence for a nonneuronal generator.**

AUTHOR: Voipio Juha (Reprint); Tallgren Pekka; Heinonen Erkki ; Vanhatalo Sampsa; Kaila Kai

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...AUTHOR: Heinonen Erkki  
2003

...ABSTRACT: of up to -2 mV at Cz versus the temporal derivations (T3/T4). Hyperventilation-like **breathing** of 5% CO<sub>2</sub>-95% O<sub>2</sub>, which does not lead to a significant hypocapnia, resulted in a near-complete block of the negative DC shift at Cz. Hypoventilation, or **breathing** 5% CO<sub>2</sub> in air at normal **respiratory** rate, induced a positive shift. The high amplitude of the voltage gradients on the scalp...

...Pco<sub>2</sub>-dependent potential difference across epithelia separating the cerebrospinal fluid and blood. Since changes in **respiratory** patterns and, hence, in the level of brain Pco<sub>2</sub>, are likely to occur under a...

DESCRIPTORS:

MISCELLANEOUS TERMS: ... **respiratory** rate

7/3,K/2 (Item 2 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0014241700 BIOSIS NO.: 200300200419

**Administration of nitric oxide into open lung regions: Delivery and monitoring.**

AUTHOR: Heinonen E (Reprint); Merilainen P; Hogman M

AUTHOR ADDRESS: Department of Medical Cell Biology, Section of Integrative Physiology, Uppsala University, SE-751 23, Box 571, Uppsala, Sweden\*\*Sweden

AUTHOR E-MAIL ADDRESS: erkki.heinonen@datex-ohmeda.com

JOURNAL: British Journal of Anaesthesia 90 (3): p338-342 March 2003. 2003

MEDIUM: print

ISSN: 0007-0912 (ISSN print)

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: English

AUTHOR: Heinonen E ...  
2003

...ABSTRACT: hypertension and in improving oxygenation. With this delivery

method the nitric oxide administration to low **ventilated** lung regions is avoided with subsequent enhancement in oxygenation. This study presents (i) pulsed administration technique for nitric oxide during artificial **ventilation** , (ii) evaluation of the delivery in an animal model, and (iii) validation of the delivery...

...3-1000 nmol. Conclusion: With pulsed administration nitric oxide therapy can be directed to well- **ventilated** lung regions. Avoiding administration to the anatomic dead space eliminates nitric oxide exhalation effectively, which...

DESCRIPTORS:

...MAJOR CONCEPTS: **Respiratory** System...

... **Respiration**

...ORGANISMS: PARTS ETC: **respiratory** system

---

7/3,K/3 (Item 3 from file: 5)  
DIALOG(R)File 5: Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0014215528 BIOSIS NO.: 200300174247

**Nebulizer apparatus**

AUTHOR: **Heinonen Erkki** (Reprint)  
AUTHOR ADDRESS: Helsinki, Finland\*\*Finland  
JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1268 (2): Mar. 11, 2003 **2003**  
MEDIUM: e-file  
PATENT NUMBER: US 6530370 PATENT DATE GRANTED: March 11, 2003 20030311  
PATENT CLASSIFICATION: 128-20016 PATENT ASSIGNEE: Instrumentation Corp.,  
Helsinki, Finland PATENT COUNTRY: USA  
ISSN: 0098-1133 (ISSN print)  
DOCUMENT TYPE: Patent  
RECORD TYPE: Abstract  
LANGUAGE: English

AUTHOR: **Heinonen Erkki** ...  
**2003**

...ABSTRACT: to atomize liquid solutions or suspensions. The nebulizer is typically used in conjunction with a **breathing** circuit to deliver atomized medicine to a patient. A housing with an opening covered by...

...vibrated at ultrasonic frequencies to atomize the liquid as it passes through the plate into **breathing** gases flowing through the **breathing** tube.

DESCRIPTORS:

...METHODS & EQUIPMENT: **breathing** circuit...

... **breathing** tube

---

7/3,K/4 (Item 4 from file: 5)  
DIALOG(R)File 5: Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0014102490 BIOSIS NO.: 200300061209

**Different toxicological profile of two COMT inhibitors in vivo: The role of uncoupling effects.**

AUTHOR: Haasio K (Reprint); Nissinen E; Sopanen L; **Heinonen E H**

AUTHOR ADDRESS: Research, Orion Pharma, FIN-02101, P.O. Box 65, Espoo,  
Finland\*\*Finland  
AUTHOR E-MAIL ADDRESS: kristiina.haasio@orionpharma.com  
JOURNAL: Journal of Neural Transmission 109 (11): p1391-1401 November 2002/  
2002  
MEDIUM: print  
ISSN: 0300-9564  
DOCUMENT TYPE: Article  
RECORD TYPE: Abstract  
LANGUAGE: English

...AUTHOR: Heinonen E H  
2002

...ABSTRACT: tolcapone- and in DNP-treated rats. These signs together with  
clinical symptoms consisting of increased **respiration**, decreased  
activity and drowsiness, and elevation of the rectal body temperature  
observed in tolcapone- and...

DESCRIPTORS:

MISCELLANEOUS TERMS: **respiration** ;

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7/3,K/5 (Item 5 from file: 5)  
DIALOG(R)File 5: Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0014064609 BIOSIS NO.: 200300023328

**Method for purging a medical fluid administration system**

AUTHOR: Heinonen Erkki (Reprint  
AUTHOR ADDRESS: Helsinki, Finland\*\*Finland  
JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1264 (1): Nov. 5, 2002, 2002  
MEDIUM: e-file  
PATENT NUMBER: US 6474333 PATENT DATE GRANTED: November 05, 2002 20021105  
PATENT CLASSIFICATION: 128-20312 PATENT ASSIGNEE: Instrumentarium Corp.,  
Helsinki, Finland PATENT COUNTRY: USA  
ISSN: 0098-1133 (ISSN print)  
DOCUMENT TYPE: Patent  
RECORD TYPE: Abstract  
LANGUAGE: English

AUTHOR: Heinonen Erkki ...  
2002

...ABSTRACT: gas administration system. In normal operation, the system  
supplies NO to the patient with the **breathing** gases inspired during the  
inspiration phase of the **respiratory** cycle. **Breathing** gases are  
expired during the expiration phase of the **respiratory** cycle. In the  
method, the expiration phase of the patient's **respiratory** cycle is  
sensed and the administration system is operated in the expiration phase  
to pass...

...through the system to flush out the system, including any NO2 present,  
into the expired **breathing** gases of the patient. Since the contents of  
the system are discharged during the expiration phase, the NO2 gas so  
removed is carried away from the patient with the expired **breathing**  
gases. The purging of the system is typically carried out at startup of  
the system...

...an expiration phase prior to administering NO during the inspiration

phases of the patient's **respiratory** cycle for medicinal purposes. The method may be used with administration systems for other types..

---

7/3,K/6 (Item 6 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013651362 BIOSIS NO.: 200200244873

**Effect of different pulses of nitric oxide on venous admixture in the anaesthetized horse**

AUTHOR: **Heinonen E** ; Nyman G; Merilainen P; Hogman M (Reprint  
AUTHOR ADDRESS: Department of Medical Cell Biology, Section of Integrative Physiology, Uppsala University, SE-75123, Uppsala, Sweden\*\*Sweden /  
JOURNAL: British Journal of Anaesthesia 88 (3): p394-398 March, 2002 2002  
MEDIUM: print  
ISSN: 0007-0912  
DOCUMENT TYPE: Article  
RECORD TYPE: Abstract  
LANGUAGE: English

**Effect of different pulses of nitric oxide on venous admixture in the anaesthetized horse**

AUTHOR: **Heinonen E** ...  
2002

...ABSTRACT: We administered NO as a pulse and varied the pulse timing during inspiration in equine **anaesthesia** , where atelectasis develops regularly. Six spontaneously **breathing** standard breed trotters were studied under isoflurane **anaesthesia** in lateral recumbency. NO pulsed into the first 30% of inspiration (group NOpI) was assumed...

...findings may be important in humans when atelectasis occurs increasingly with overweight and age during **anaesthesia** , but also in postoperative intensive care and in ARDS.

DESCRIPTORS:

MAJOR CONCEPTS: **Respiratory** System...

... **Respiration** ;

...ORGANISMS: PARTS ETC: **respiratory** system, open area

...DISEASES: **respiratory** system disease, therapy

MISCELLANEOUS TERMS: ... **ventilation** -perfusion mismatch

---

7/3,K/7 (Item 7 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013535116 BIOSIS NO.: 200200128627

**Method and arrangement for vaporizing an anaesthetic**

AUTHOR: Sarela A; **Heinonen E**  
AUTHOR ADDRESS: Espoo, Finland\*\*Finland  
JOURNAL: Official Gazette of the United States Patent and Trademark Office Patents 1216 (2): p1351-1352 Nov. 10, 1998 1998  
MEDIUM: print  
PATENT NUMBER: US 5832917 PATENT DATE GRANTED: Nov. 10, 1998 19981110  
PATENT CLASSIFICATION: 128-203.12 PATENT ASSIGNEE: INSTRUMENTARIUM OY  
PATENT COUNTRY: USA  
ISSN: 0098-1133  
DOCUMENT TYPE: Patent

RECORD TYPE: Citation  
LANGUAGE: English

**Method and arrangement for vaporizing an anaesthetic**

...AUTHOR: Heinonen E  
1998

DESCRIPTORS:

MISCELLANEOUS TERMS: ANESTHESIA VAPORIZING METHODS...

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7/3,K/8 (Item 8 from file: 5)

DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013535088 BIOSIS NO.: 200200128599

**Method and assembly for filling an anesthetic evaporator**

AUTHOR: Kankkunen J; Heinonen E

AUTHOR ADDRESS: Vantaa, Finland\*\*Finland

JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1215 (2): p1382-1383 Oct. 13, 1998 1998

MEDIUM: print

PATENT NUMBER: US 5819814 / PATENT DATE GRANTED: Oct. 13, 1998 19981013

PATENT CLASSIFICATION: 141-18 PATENT ASSIGNEE: INSTRUMENTARIUM OY

PATENT COUNTRY: USA

ISSN: 0098-1133

DOCUMENT TYPE: Patent

RECORD TYPE: Citation

LANGUAGE: English

**Method and assembly for filling an anesthetic evaporator**

...AUTHOR: Heinonen E  
1998

DESCRIPTORS:

MISCELLANEOUS TERMS: ANESTHETIC TRANSPORT CONTAINER...

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7/3,K/9 (Item 9 from file: 5)

DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013531210 BIOSIS NO.: 200200124721

**Arrangement in connection with an anaesthetic liquid container**

AUTHOR: Heinonen E ; Sarela A; Kankkunen J

AUTHOR ADDRESS: Helsinki, Finland\*\*Finland

JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1214 (1): p143-144 Sept. 1, 1998 1998

MEDIUM: print

PATENT NUMBER: US 5799711 PATENT DATE GRANTED: Sept. 1, 1998 19980901

PATENT CLASSIFICATION: 141-18 PATENT ASSIGNEE: INSTRUMENTARIUM OY

PATENT COUNTRY: USA

ISSN: 0098-1133

DOCUMENT TYPE: Patent

RECORD TYPE: Citation

LANGUAGE: English

**Arrangement in connection with an anaesthetic liquid container**

AUTHOR: Heinonen E ...  
1998

DESCRIPTORS:

MISCELLANEOUS TERMS: ANESTHETIC LIQUID CONTAINER...

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7/3,K/10 (Item 10 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013487077 BIOSIS NO.: 200200080588

**Method and apparatus for metering an anaesthetic to a patient**

AUTHOR: Heinonen E

AUTHOR ADDRESS: Helsinki, Finland\*\*Finland

JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1200 (4): p2590 July 22, 1997 1997

MEDIUM: print

PATENT NUMBER: US 5649531 PATENT DATE GRANTED: July 22, 1997 19970722

PATENT CLASSIFICATION: 128-203.12 PATENT ASSIGNEE: INSTRUMENTARIUM

CORPORATION PATENT COUNTRY: USA

ISSN: 0098-1133

DOCUMENT TYPE: Patent

RECORD TYPE: Citation

LANGUAGE: English

**Method and apparatus for metering an anaesthetic to a patient**

AUTHOR: Heinonen E

1997

DESCRIPTORS:

MISCELLANEOUS TERMS: ANESTHESIA DELIVERY...

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7/3,K/11 (Item 11 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013469503 BIOSIS NO.: 200200063014

**Arrangement for overflow protection of a container for anaesthetic liquid**

AUTHOR: Kankkunen J; Heinonen E

AUTHOR ADDRESS: Helsinki, Finland\*\*Finland

JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1196 (3): p1621-1622 March 18, 1997 1997

MEDIUM: print

PATENT NUMBER: US 5611375 PATENT DATE GRANTED: March 18, 1997 19970318

PATENT CLASSIFICATION: 141-18 PATENT ASSIGNEE: INSTRUMENTARIUM CORP.

PATENT COUNTRY: USA

ISSN: 0098-1133

DOCUMENT TYPE: Patent

RECORD TYPE: Citation

LANGUAGE: English

**Arrangement for overflow protection of a container for anaesthetic liquid**

...AUTHOR: Heinonen E

1997

DESCRIPTORS:

MISCELLANEOUS TERMS: ANESTHETIC LIQUID...

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7/3,K/12 (Item 12 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013441600 BIOSIS NO.: 200200035111

**Regulation of a propellant gas flow**

AUTHOR: **Heinonen E ; Hyvonen M**  
AUTHOR ADDRESS: Helsinki, Finland\*\*Finland  
JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1183 (2): p649-650 Feb. 13, 1996 1996  
MEDIUM: print  
PATENT NUMBER: US 5490499 PATENT DATE GRANTED: Feb. 13, 1996 19960213  
PATENT CLASSIFICATION: 128-203.28 PATENT ASSIGNEE: INSTRUMENTARIUM CORP.  
PATENT COUNTRY: USA  
ISSN: 0098-1133  
DOCUMENT TYPE: Patent  
RECORD TYPE: Citation  
LANGUAGE: English

AUTHOR: **Heinonen E ...**  
**1996**

DESCRIPTORS:

...MAJOR CONCEPTS: **Respiratory System...**

... **Respiration ;**

MISCELLANEOUS TERMS: ... **RESPIRATORY CYCLE**

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**7/3,K/13 (Item 13 from file: 5)**  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013245105 BIOSIS NO.: 200100416944

**Evaluation of the hepatotoxic potential of COMT inhibitors: The role of mitochondria**

AUTHOR: Nissinen Erkki (Reprint); Haasio Kristiina (Reprint); Sopanen Leena (Reprint); **Heinonen Esa H** (Reprint)

AUTHOR ADDRESS: Espoo, Finland\*\*Finland

JOURNAL: Neurology 56 (8 Supplement 3): pA344 April 24, 2001 2001

MEDIUM: print

CONFERENCE/MEETING: 53rd Annual Meeting of the American Academy of Neurology Philadelphia, PA, USA May 05-11, 2001; 20010505

SPONSOR: American Academy of Neurology

ISSN: 0028-3878

DOCUMENT TYPE: Meeting; Meeting Abstract; Meeting Poster

RECORD TYPE: Citation

LANGUAGE: English

...AUTHOR: **Heinonen Esa H**  
**2001**

DESCRIPTORS:

MISCELLANEOUS TERMS: ... **respiration rate**

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**7/3,K/14 (Item 14 from file: 5)**  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013214811 BIOSIS NO.: 200100386650

**Tracheal gas insufflation delivery system for respiration equipment**

AUTHOR: **Heinonen Erkki P O** (Reprint); Larsson Lars A

AUTHOR ADDRESS: Helsinki, Finland\*\*Finland

JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1244 (1): Mar. 6, 2001 2001

MEDIUM: e-file

PATENT NUMBER: US 6196222 PATENT DATE GRANTED: March 06, 2001 20010306

PATENT CLASSIFICATION: 128-20423 PATENT ASSIGNEE: Instrumentarium Corporation, Helsinki, Finland PATENT COUNTRY: USA  
ISSN: 0098-1133  
DOCUMENT TYPE: Patent  
RECORD TYPE: Abstract  
LANGUAGE: English

**Tracheal gas insufflation delivery system for respiration equipment**  
AUTHOR: Heinonen Erkki P O ...  
2001

ABSTRACT: A tracheal gas **insufflation** delivery system for use with a **ventilator breathing** system including a **ventilator** and a **breathing** circuit. The delivery system includes a flow generator connected to the inspiratory limb of the **breathing** circuit through an inlet line. The flow generator is operated to draw off a supply...

...The flow generator is connected by a delivery line to the patient limb of the **breathing** circuit, preferably, near the distal end of an endotracheal tube used in the patient limb. The gas supplied by the delivery line reduces the volume of previously exhaled gases subsequently **breathed** by the patient increasing the physiological efficiency of patient **ventilation** and allowing a reduction in **ventilatory** pressures. The tracheal gas **insufflation** delivery system may include an intermediate cylinder that can be filled by the flow generator so that the tracheal gas **insufflation** delivery system can deliver a greater supply of gas.

DESCRIPTORS:

METHODS & EQUIPMENT: tracheal gas **insufflation** delivery system...  
...drug delivery equipment, **respiratory** equipment...  
... **ventilator breathing** system

---

7/3,K/15 (Item 15 from file: 5)  
DIALOG(R)File 5: Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013098798 BIOSIS NO.: 200100270637

**Method and apparatus for detecting an empty breathing gas compartment in a patient ventilator**

AUTHOR: Heinonen Erkki (Reprint  
AUTHOR ADDRESS: Helsinki, Finland\*\*Finland  
JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1240 (4): Nov. 28, 2000 2000  
MEDIUM: e-file  
PATENT NUMBER: US 6152131 PATENT DATE GRANTED: November 28, 2000 20001128  
PATENT CLASSIFICATION: 128-20423 PATENT ASSIGNEE: Instrumentarium Corp., Helsinki, Finland PATENT COUNTRY: USA  
ISSN: 0098-1133  
DOCUMENT TYPE: Patent  
RECORD TYPE: Abstract  
LANGUAGE: English

**Method and apparatus for detecting an empty breathing gas compartment in a patient ventilator**

AUTHOR: Heinonen Erkki ...  
2000

ABSTRACT: An apparatus/method for detecting an empty **breathing** gas

compartment condition in a bellows **ventilator** for a patient. The apparatus includes a first sensor for measuring, during inspiration, the incoming...

...value will be large if the bellows is movable, i.e. not in the empty **breathing** compartment gas condition. The compliance value is small if the empty **breathing** gas compartment condition exists. The compliance value, so determined, is compared with a reference compliance value in the control unit to detect the empty **breathing** gas compartment condition.

DESCRIPTORS:

METHODS & EQUIPMENT: **breathing** detection...

...empty **breathing** gas compartment detector...

MISCELLANEOUS TERMS: patient **ventilator**

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7/3,K/16 (Item 16 from file: 5)  
DIALOG(R)File 5: BIOSIS Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013078522 BIOSIS NO.: 200100250361

**Method for measuring pulmonary functional residual capacity**

AUTHOR: **Heinonen Erkki** (Reprint

AUTHOR ADDRESS: Helsinki, Finland\*\*Finland

JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1239 (5); Oct. 31, 2000 2000

MEDIUM: e-file

PATENT NUMBER: US 6139506 / PATENT DATE GRANTED: October 31, 2000 20001031

PATENT CLASSIFICATION: 600-532 PATENT ASSIGNEE: Instrumentarium Oy,  
Helsinki, Finland PATENT COUNTRY: USA

ISSN: 0098-1133

DOCUMENT TYPE: Patent

RECORD TYPE: Abstract

LANGUAGE: English

AUTHOR: **Heinonen Erkki** ...  
2000

...ABSTRACT: pulmonary functional residual capacity (FRC). A given amount of indicator gas is delivered into the **breathing** gases flowing into the lungs of a subject in a selected number of sequential **breaths**. The amounts of indicator gas delivered during the selected number of **breaths** are summed to provide a cumulative total (SIGMAVin). The amount of indicator gas exhaled in the number of sequential **breaths** is summed to provide a cumulative total (SIGMAVout). An indication of the concentration of indicator gas in the lungs of the subject (FET) is obtained for said two or more **breaths**. Using the quantities (SIGMAVin), (SIGMAVout), and (FET) as measured variables, at least two measured value

DESCRIPTORS:

...ORGANISMS: PARTS ETC: **respiratory** system

---

7/3,K/17 (Item 17 from file: 5)  
DIALOG(R)File 5: BIOSIS Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0013076261 BIOSIS NO.: 200100248100

**Medical dosing device having dosing chamber with a pressure sensor**

AUTHOR: **Heinonen Erkki** (Reprint  
AUTHOR ADDRESS: Helsinki, Finland\*\*Finland  
JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1239 (3): Oct. 17, 2000 - 2000  
MEDIUM: e-file  
PATENT NUMBER: US 6131572 PATENT DATE GRANTED: October 17, 2000 20001017  
PATENT CLASSIFICATION: 128-20524 PATENT ASSIGNEE: Instrumentarium Oy,  
Helsinki, Finland PATENT COUNTRY: USA  
ISSN: 0098-1133  
DOCUMENT TYPE: Patent  
RECORD TYPE: Abstract  
LANGUAGE: English

AUTHOR: **Heinonen Erkki** ....  
2000

...ABSTRACT: small discrete volumes of gas, for example sulfur hexa  
fluoride or nitric oxide, to the **breathing** gases of a patient. The  
device includes a charging valve interposed between a gas supply...

---

7/3,K/18 (Item 18 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0012987616 BIOSIS NO.: 200100159455

**Comparative toxicological study on the hepatic safety of entacapone and  
tolcapone in the rat**

AUTHOR: Haasio K (Reprint); Sopanen L; Vaalavirta L; Linden I-B; **Heinonen  
E H**

AUTHOR ADDRESS: Research, Orion Pharma, FIN-02101, Espoo, Finland\*\*Finland  
JOURNAL: Journal of Neural Transmission 108 (1): p79-91 January 24, 2001  
2001

MEDIUM: print  
ISSN: 0300-9564  
DOCUMENT TYPE: Article  
RECORD TYPE: Abstract  
LANGUAGE: English

...AUTHOR: **Heinonen E H**  
2001

...ABSTRACT: treatment and induced signs of toxicity such as a rise in body  
temperature, stimulation of **respiration** and rapid onset of rigor mortis  
after death. Entacapone did not show any adverse effects...

---

7/3,K/19 (Item 19 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0012684325 BIOSIS NO.: 200000402638

**Variable orifice pulse valve**

AUTHOR: **Heinonen Erkki** (Reprint

AUTHOR ADDRESS: Helsinki, Finland\*\*Finland

JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1232 (1): Mar. 7, 2000 2000

MEDIUM: e-file

PATENT NUMBER: US 6032667 PATENT DATE GRANTED: March 07, 2000 20000307

PATENT CLASSIFICATION: 128-20524 PATENT ASSIGNEE: Instrumentarium

Corporation, Helsinki, Finland PATENT COUNTRY: USA  
ISSN: 0098-1133  
DOCUMENT TYPE: Patent  
RECORD TYPE: Abstract  
LANGUAGE: English

AUTHOR: Heinonen Erkki ...  
2000

...ABSTRACT: supply a very small quantity of a therapeutic gas or a  
diagnostic gas into the **breathing** gases of a patient. The valve has a  
housing with an inlet for receiving the...

---

7/3,K/20 (Item 20 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0012289216 BIOSIS NO.: 200000007529  
Ventilator for intensified breathing and valve in patient conduit of  
apparatus for intensified breathing  
AUTHOR: Heinonen Erkki (Reprint); Bromster Leif  
AUTHOR ADDRESS: Department of Surgery, Division of Transplantation,  
Helsinki University Central Hospital, Helsinki, Finland\*\*Finland  
JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1226 (3): Sep. 21, 1999 1999  
MEDIUM: print  
PATENT NUMBER: US 5954051 PATENT DATE GRANTED: Sep. 21, 1999 19990921  
PATENT CLASSIFICATION: 128-20524 PATENT ASSIGNEE: Instrumentarium Oy  
PATENT COUNTRY: USA  
ISSN: 0098-1133  
DOCUMENT TYPE: Patent  
RECORD TYPE: Citation  
LANGUAGE: English

Ventilator for intensified breathing and valve in patient conduit of  
apparatus for intensified breathing  
AUTHOR: Heinonen Erkki ...  
1999  
DESCRIPTORS:  
METHODS & EQUIPMENT: ventilator --...

...intensified **breathing** , medical equipment, safety valve

---

7/3,K/21 (Item 21 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0012158603 BIOSIS NO.: 199900418263  
Special gas dose delivery apparatus for respiration equipment  
AUTHOR: Heinonen Erkki (Reprint)  
AUTHOR ADDRESS: Department of Surgery, Division of Transplantation,  
Helsinki University Central Hospital, Helsinki, Finland\*\*Finland  
JOURNAL: Official Gazette of the United States Patent and Trademark Office  
Patents 1224 (1): Jul. 6, 1999 1999  
MEDIUM: print  
PATENT NUMBER: US 5918596 PATENT DATE GRANTED: Jul. 06, 1999 19990706  
PATENT CLASSIFICATION: 128-20421 PATENT ASSIGNEE: Instrumentarium Corp.  
PATENT COUNTRY: USA

ISSN: 0098-1133  
DOCUMENT TYPE: Patent  
RECORD TYPE: Citation  
LANGUAGE: English

**Special gas dose delivery apparatus for respiration equipment**

AUTHOR: Heinonen Erkki ...

1999

DESCRIPTORS:

...MAJOR CONCEPTS: **Respiration**

...METHODS & EQUIPMENT: medical equipment, **respiratory** equipment...

---

7/3,K/22 (Item 22 from file: 5)

DIALOG(R)File 5:Biosis Previews(R)

(c) 2004 BIOSIS. All rts. reserv.

0011970629 BIOSIS NO.: 199900230289

**Effects of voluntary hyperventilation on cortical sensory responses:**

**Electroencephalographic and magnetoencephalographic studies**

AUTHOR: Huttunen J (Reprint); Tolvanen H; **Heinonen E** ; Voipio J; Wikstrom H; Ilmoniemä R J; Hari R; Kaila K

AUTHOR ADDRESS: BioMag Laboratory, Medical Engineering Centre, Helsinki University Central Hospital, FIN-00029 HYKS, Helsinki, Finland\*\*Finland

JOURNAL: Experimental Brain Research 125 (3): p248-254 April, 1999 **1999**

MEDIUM: print

ISSN: 0014-4819

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: English

...AUTHOR: **Heinonen E**

1999

...ABSTRACT: 10 min after the end of HV. The AEPs were not altered when the subjects **breathed** 5% CO<sub>2</sub> in air in a hyperventilation-like manner, which prevented the development of hypocapnia...

---

7/3,K/23 (Item 23 from file: 5)

DIALOG(R)File 5:Biosis Previews(R)

(c) 2004 BIOSIS. All rts. reserv.

0010893858 BIOSIS NO.: 199799527918

**Attenuation of the auditory evoked potential N100 and a negative shift in**

**DC-EEG caused by voluntary hyperventilation**

AUTHOR: Tolvanen H; **Heinonen E** ; Voipio J; Kaila K

AUTHOR ADDRESS: Dep. Biosci., PO Box 17, Univ. Helsinki, 00014 Helsinki, Finland\*\*Finland

JOURNAL: International Journal of Psychophysiology 25 (1): p44 1997 **1997**

CONFERENCE/MEETING: Twelfth International Organization of Psychophysiology Meeting. Tampere, Finland June 25-29, 1996; 19960625

ISSN: 0167-8760

DOCUMENT TYPE: Meeting; Meeting Abstract

RECORD TYPE: Citation

LANGUAGE: English

...AUTHOR: **Heinonen E**

1997

DESCRIPTORS:

...MAJOR CONCEPTS: **Respiratory** System...

... **Respiration** ;

MISCELLANEOUS TERMS: ...INTENSIVE **BREATHING** ; ...

... **RESPIRATORY** ALKALOSIS

---

7/3,K/24 (Item 24 from file: 5)

DIALOG(R)File 5:Biosis Previews(R)

(c) 2004 BIOSIS. All rts. reserv.

0007519593 BIOSIS NO.: 199141032219

**DETECTION OF DIABETIC AUTONOMIC NEUROPATHY WITH SPECTRAL ANALYSIS OF HEART RATE**

AUTHOR: **HEINONEN E H** (Reprint); **VIKARI J**; **MOLNAR G**; **LANG H H**; **JALONEN J**; **ANTILA K**; **VALIMAKI I**

AUTHOR ADDRESS: **TURKU, FINLAND\*\*FINLAND**

JOURNAL: **Neurology** 41 (3 SUPPL. 1): p311 1991

CONFERENCE/MEETING: 43RD ANNUAL MEETING OF THE AMERICAN ACADEMY OF NEUROLOGY, BOSTON, MASSACHUSETTS, USA, APRIL 20-27, 1991. **NEUROLOGY**.

ISSN: 0028-3878

DOCUMENT TYPE: Meeting

RECORD TYPE: Citation

LANGUAGE: **ENGLISH**

AUTHOR: **HEINONEN E H** ...

1991

DESCRIPTORS: **ABSTRACT HUMAN ELECTROCARDIOGRAPHY** **BREATHING** **CHANGES** **DIAGNOSIS**

DESCRIPTORS:

...MAJOR CONCEPTS: **Respiratory** System...

... **Respiration**

---

7/3,K/25 (Item 25 from file: 5)

DIALOG(R)File 5:Biosis Previews(R)

(c) 2004 BIOSIS. All rts. reserv.

0006772107 BIOSIS NO.: 198988087222

**VINCRIStINE TREATMENT OF ACUTE LYMPHOBLASTIC LEUKEMIA INDUCES TRANSIENT AUTONOMIC CARDIONEUROPATHY**

AUTHOR: **HIRVONEN H E** (Reprint); **SALMI T T**; **HEINONEN E** ; **ANTILA K J**; **VALIMAKI I A T**

AUTHOR ADDRESS: **CARDIORESPIR RES UNIT, UNIV TURKU, KIINAMYLlynKATU 10, SF-20520 TURKU, FINLAND\*\*FINLAND**

JOURNAL: **Cancer** 64 (4): p801-805 1989

ISSN: 0008-543X

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: **ENGLISH**

...AUTHOR: **HEINONEN E**

1989

ABSTRACT: Reduced **respiratory** sinus arrhythmia, measured as heart rate variability, is a reliable indicator of autonomic nervous dysfunction...

...phases as compared to the consolidation and maintenance phases without vincristine administration. In particular, the **respiratory** components



of the HRV during deep **breathing** tests were significantly reduced during vincristine treatment. The authors conclude that the measurement of the...

---

7/3,K/26 (Item 26 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0006041593 BIOSIS NO.: 198885010484

**SPIROMETERS A FIELD TEST EVALUATION**

AUTHOR: **HEINONEN E** (Reprint

AUTHOR ADDRESS: ACADEMY FINLAND, LAAKSO HOSPITAL, LAAKARINKATU 6B, 00250  
HELSINKI, FINLAND\*\*FINLAND

JOURNAL: Clinical Respiratory Physiology 23 (2): p177-180 1987

ISSN: 0272-7587

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: ENGLISH

AUTHOR: **HEINONEN E** ...

1987

DESCRIPTORS:

...MAJOR CONCEPTS: **Respiratory** System...

... **Respiration**

---

7/3,K/27 (Item 27 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0005696824 BIOSIS NO.: 198784050973

**AUTONOMIC NEUROPATHY AND VIBRATION EXPOSURE IN FORESTRY WORKERS**

AUTHOR: **HEINONEN E** (Reprint); FARKKILA M; FORSSTROM J; ANTILA K; JALONEN  
J; KORHONEN O; PYYKKO I

AUTHOR ADDRESS: CARDIORESPIRATORY RES UNIT, UNIV TURKU, TURKU, FINL\*\*  
FINLAND

JOURNAL: British Journal of Industrial Medicine 44 (6): p412-416 1987

ISSN: 0007-1072

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: ENGLISH

AUTHOR: **HEINONEN E** ...

1987

ABSTRACT: The variation in heart rate (HRV) at rest and during deep **breathing** (6 cycles a minute) of 88 professional lumber jacks was studied using a computer technique...

...There was a significant difference ( $p < 0.001$ ) between the HRV indexes during the deep **breathing** test in those with the shortest (CV = 10.1  $\pm$  1.1) and those with the...

...those with the longest and those with the shortest exposures. The HRV during a deep **breathing** test is associated with the activity of the parasympathetic nervous system and is decreased in...

---

7/3,K/28 (Item 28 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0005588470 BIOSIS NO.: 198783067361

**REACTIVITY OF AUTONOMIC NERVOUS CONTROL OF HEART RATE IN DIABETES MELLITUS  
AND JUVENILE RHEUMATOID ARTHRITIS**

AUTHOR: LINDQVIST A (Reprint); ERKOLAHTI R; HEINONEN E ; VALIMAKI I  
AUTHOR ADDRESS: CARDIORESPIRATORY RES UNIT, UNIV OF TURKU, SF-20520 TURKU  
52, FINLAND\*\*FINLAND

JOURNAL: Scandinavian Journal of Clinical and Laboratory Investigation 46  
(8): p771-778 1986

ISSN: 0036-5513

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: ENGLISH

...AUTHOR: HEINONEN E  
1986

...ABSTRACT: 12) and healthy controls (n = 12) was studied by a procedure consisting of a deep **breathing** test and an intermittent tilting test. Frequency selective entrainment of HR could be produced by tilting and deep **breathing**. No statistically significant intergroup differences were detected in the patterns of average heart rate (HR...

DESCRIPTORS: HUMAN DEEP **BREATHING** TEST INTERMITTENT TILTING TEST

7/3,K/29 (Item 29 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
(c) 2004 BIOSIS. All rts. reserv.

0005552343 BIOSIS NO.: 198783031234

**EFFECTS OF HEMODIALYSIS ON HEART RATE VARIABILITY IN CHRONIC RENAL FAILURE**

AUTHOR: FORSSTROM J (Reprint); FORSSTROM J; HEINONEN E ; VALIMAKI I;  
ANTILA K

AUTHOR ADDRESS: CARDIORESPIRATORY RES UNIT, UNIV TURKU, KIINAMYLlynKATU 10,  
SF-20520 TURKU, FINLAND\*\*FINLAND

JOURNAL: Scandinavian Journal of Clinical and Laboratory Investigation 46  
(7): p665-670 1986

ISSN: 0036-5513

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: ENGLISH

...AUTHOR: HEINONEN E  
1986

...ABSTRACT: patients on maintenance haemodialysis. The R-R intervals were measured in recordings during spontaneous quiet **breathing** and during controlled deep **breathing** before and after a single HD session. The HRV was expressed as the standard deviation...

...the heart rate mainly caused by autonomic control mechanisms. The long-term HRV during quiet **breathing** was statistically significantly (p < 0.05) higher after the HD than before. The HRV in...

7/3,K/30 (Item 30 from file: 5)  
DIALOG(R)File 5:Biosis Previews(R)  
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0003929725 BIOSIS NO.: 198376021160

**DIFFERENTIAL SENSITIVITY OF A AND C NERVE FIBERS TO LONG-ACTING AMIDE LOCAL ANESTHETICS**

AUTHOR: ROSENBERG P H (Reprint); HEINONEN E

AUTHOR ADDRESS: DEP ANAESTHESIA, SURGICAL HOSP, HELSINKI UNIV CENTRAL HOSP, SF-00130 HELSINKI 13, FINLAND\*\*FINLAND

JOURNAL: British Journal of Anaesthesia 55 (2): p163-168 1983

ISSN: 0007-0912

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: ENGLISH

**DIFFERENTIAL SENSITIVITY OF A AND C NERVE FIBERS TO LONG-ACTING AMIDE LOCAL ANESTHETICS**

...AUTHOR: HEINONEN E

1983

DESCRIPTORS: RAT BUPIVACAINE ETIDOCAINE AL-381 LOCAL ANESTHETIC PHARMACODYNAMICS

---

7/3,K/31 (Item 31 from file: 5)

DIALOG(R)File 5: Biosis Previews(R)

(c) 2004 BIOSIS. All rts. reserv.

0003256978 BIOSIS NO.: 198171075937

**DIFFERENTIAL NERVE BLOCK BY BUPIVACAINE AND 2 CHLORO PROCAINE AN EXPERIMENTAL STUDY**

AUTHOR: ROSENBERG P H (Reprint); HEINONEN E ; JANSSON S-E; GRIPENBERG J

AUTHOR ADDRESS: DEPARTMENT OF ANAESTHESIOLOGY, UNIVERSITY OF HELSINKI, SF-00290 HELSINKI 29, FINLAND\*\*FINLAND

JOURNAL: British Journal of Anaesthesia 52 (12): p1183-1190 1980

ISSN: 0007-0912

DOCUMENT TYPE: Article

RECORD TYPE: Abstract

LANGUAGE: ENGLISH

...AUTHOR: HEINONEN E

1980

...ABSTRACT: action potential amplitude of the A fibers was still .apprx. 35%. Although these 2 local anesthetics differ structurally and physico-chemically, the rates of block of the the different fibers were ...

DESCRIPTORS: RABBIT CERVICAL SYMPATHETIC TRUNK PHRENIC NERVE LOCAL ANESTHETIC MYELINATED UNMYELINATED ACTION POTENTIAL PHARMACODYNAMICS

---

7/3,K/32 (Item 1 from file: 34)

DIALOG(R)File 34: SciSearch(R) Cited Ref Sci

(c) 2004 Inst for Sci Info. All rts. reserv.

08959820 Genuine Article#: 349WL No. References: 23

**Title: Theoretical and experimental comparison of constant inspired concentration and pulsed delivery in NO therapy**

Author(s): Heinonen E ; Hogman M; Merilainen P (REPRINT)

Corporate Source: UNIV UPPSALA, DEPT MED SCI/S-75185 UPPSALA//SWEDEN/ (REPRINT); UNIV UPPSALA, DEPT MED SCI/S-75185 UPPSALA//SWEDEN/; DATEX OHMEDA RES UNIT, /HELSINKI//FINLAND/

Journal: INTENSIVE CARE MEDICINE, 2000, V26, N8 (AUG), P1116-1123

ISSN: 0342-4642 Publication date: 20000800  
Publisher: SPRINGER-VERLAG, 175 FIFTH AVE, NEW YORK, NY 10010  
Language: English Document Type: ARTICLE (ABSTRACT AVAILABLE)

Author(s): **Heinonen E** ; Hogman M; Merilainen P (REPRINT)  
, 2000

Abstract: Objective: Inhaled NO therapy of artificially **ventilated** patients has been established as being based on constant inspired concentration of NO. In this...

...uptake, a mathematical lung model was created where NO delivery can be simulated in varying **ventilator** settings, delivery modes, and lung properties. This model and the efficacy of pulsed delivery in...  
...performed with nine pigs of mixed breed weighing 25-35 kg.

Interventions: The pigs were **anaesthetised** and artificially **ventilated** . Pulmonary vasoconstriction was induced by hypoxia. NO was delivered periodically in the various delivery modes...

...simulation, in all delivery modes the NO uptake was found to be dependent on the **ventilator** settings and the volume of the dead space. Measured from pulmonary artery pressure, the pulsed...

...Based on the simulation, the alveolar NO fraction and the NO uptake depend on the **ventilator** settings and the dead space in both volumetric- and concentration-based delivery.

Conclusions: With pulsed...  
...Identifiers--INHALED NITRIC-OXIDE; PRIMARY PULMONARY-HYPERTENSION;  
**RESPIRATORY** -DISTRESS-SYNDROME; LONG-TERM INHALATION; RELAXING FACTOR;  
OXYGENATION; SYSTEM

---

1 7/3,K/33 (Item 2 from file: 34)  
DIALOG(R)File 34:SciSearch(R) Cited Ref Sci  
(c) 2004 Inst for Sci Info. All rts. reserv.

03609567 Genuine Article#: PR095 No. References: 54

**Title: SELEGILINE IN THE TREATMENT OF NARCOLEPSY**

Author(s): HUBLIN C; PARTINEN M; **HEINONEN EH** ; PUUKKA P; SALMI T  
Corporate Source: UNIV HELSINKI, DEPT NEUROL, HAARTMANINKATU 4/SF-00290  
HELSINKI//FINLAND/; ORION CORP FARMOS, PHARMACEUT/SF-20101  
TURKU//FINLAND/; ULLANLINNA SLEEP RES CTR/HELSINKI//FINLAND/

Journal: NEUROLOGY, 1994 , V44, N11 (NOV), P2095-2101

ISSN: 0028-3878

Language: ENGLISH Document Type: ARTICLE (Abstract Available)

Author(s): HUBLIN C; PARTINEN M; **HEINONEN EH** ; PUUKKA P; SALMI T  
, 1994

...Research Fronts: LIKE EPISODES (MELAS); OXIDATIVE STRESS; MPTP  
MECHANISMS)

92-8022 001 (MENTAL SLEEP EXPERIENCE; UPPER AIRWAY **ANESTHESIA** DELAYS  
AROUSAL; ADOLESCENT DEPRESSION)

---

7/3,K/34 (Item 1 from file: 35)  
DIALOG(R)File 35:Dissertation Abs Online  
(c) 2004 ProQuest Info&Learning. All rts. reserv.

01911514 ORDER NO: AADAA-IC810004

**Synchronized delivery of inspired nitric oxide: Effects on oxygenation and pulmonary tension during artificial ventilation**

Author: Heinonen, Erkki

Degree: Ph.D.

Year: 2002

Corporate Source/Institution: Uppsala Universitet (Sweden) (0903)

Source: VOLUME 63/04-C OF DISSERTATION ABSTRACTS INTERNATIONAL.

PAGE 697. 58 PAGES

ISBN: 91-554-5337-6

Publisher: Uppsala University Library, Box 510, SE-751 20 Uppsala, Sweden

**Synchronized delivery of inspired nitric oxide: Effects on oxygenation and pulmonary tension during artificial ventilation**

Author: Heinonen, Erkki

Year: 2002

...vasodilator to relieve pulmonary hypertension or to improve oxygenation with no systemic effects. In artificial **ventilation** nitric oxide has been administered in inspiration gas as a continuous gas flow or to...

...theoretically and experimentally with the aim to relieve pulmonary hypertension and improve oxygenation during artificial **ventilation**. For the experimental study a system for the synchronized administration was developed.

The effect on oxygenation was studied during equine **anaesthesia** where hypoxemia develops regularly secondary to left-to-right shunt caused by atelectasis. By administering the NO as a short pulse in early inspiration to well **ventilated** lung areas the oxygenation could be effectively improved. Delayed administration to low **ventilated** lung areas was found possible for a negative contribution on oxygenation, which reduces the improvement gained in the well- **ventilated** lung areas. When NO is delivered into the whole inspiration, the net effect on oxygenation...

---

7/3,K/35 (Item 1 from file: 73)

DIALOG(R)File 73:EMBASE

(c) 2004 Elsevier Science B.V. All rts. reserv.

03510857 EMBASE No: 1987027793

**Effects of repeated bupivacaine administration on sciatic nerve and surrounding muscle tissue in rats**

Kytta J.; Heinonen E. ; Rosenberg P.H.; et al.

Department of Anaesthesiology, Toolo Hospital, Helsinki University Central Hospital, SF-00260 Helsinki 26 Finland

Acta Anaesthesiologica Scandinavica ( ACTA ANAESTHESIOLOG. SCAND. ) ( Denmark) 1986, 30/8 (625-629)

CODEN: AANEA

DOCUMENT TYPE: Journal

LANGUAGE: ENGLISH

Kytta J.; Heinonen E. ; Rosenberg P.H.; et al.

**SECTION HEADINGS:**

037 Drug Literature Index

024 **Anesthesiology**

030 Clinical and Experimental Pharmacology

052 Toxicology

008 Neurology and Nerosurgery

1986

---

7/3,K/36 (Item 2 from file: 73)  
DIALOG(R)File 73:EMBASE  
(c) 2004 Elsevier Science B.V. All rts. reserv.

02638221 EMBASE No: 1984157179

**Prospidin chemotherapy in recurrent head and neck carcinoma: A phase II study**

Grohn P.; **Heinonen E.** ; Appelqvist P.; et al.  
Department of Radiotherapy and Oncology, Helsinki University Central  
Hospital, Helsinki Finland  
Cancer Treatment Reports ( CANCER TREAT. REP. ) (United States) 1984,  
68/6 (915-917)  
CODEN: CTRRD  
DOCUMENT TYPE: Journal  
LANGUAGE: ENGLISH

Grohn P.; **Heinonen E.** ; Appelqvist P.; et al.  
MEDICAL DESCRIPTORS:  
chemotherapy; blood and hemopoietic system; **respiratory** system; therapy;  
intoxication; larynx; intravenous drug administration; human; clinical  
article  
1984

---

7/3,K/37 (Item 3 from file: 73)  
DIALOG(R)File 73:EMBASE  
(c) 2004 Elsevier Science B.V. All rts. reserv.

02256999 EMBASE No: 1982050160

**Independent release of supranormal acetylcholine quanta at the rat neuromuscular junction**

**Heinonen E.** ; Jansson S.-E.; Tolppanen E.-M.  
Dept. Physiol., Univ. Helsinki Finland  
Neuroscience ( NEUROSCIENCE ) (United Kingdom) 1982, 7/1 (21-24)  
CODEN: NRSCD  
DOCUMENT TYPE: Journal  
LANGUAGE: ENGLISH

**Heinonen E.** ; Jansson S.-E.; Tolppanen E.-M.  
SECTION HEADINGS:  
002 Physiology  
024 **Anesthesiology**  
008 Neurology and Nerosurgery  
1982

---

7/3,K/38 (Item 1 from file: 94)  
DIALOG(R)File 94:JICST-EPlus  
(c)2004 Japan Science and Tech Corp(JST). All rts. reserv.

01129118 JICST ACCESSION NUMBER: 90A0611497 FILE SEGMENT: JICST-E

**Vibration stress and the Autonomic Nervous System.**

FAERKKILAE M (1); PYYKKOE I (1); **HEINONEN E** (1)  
(1): University Hospital of Helsinki, Helsinki, FIN  
Kurume Med J, 1990 , VOL.37,NO.Suppl, PAGE.S53-S60, FIG.3, TBL.3, REF.25  
JOURNAL NUMBER: F0811AAJ ISSN NO: 0023-5679 CODEN: KRMJA  
UNIVERSAL DECIMAL CLASSIFICATION: 613.62+616-057  
LANGUAGE: English COUNTRY OF PUBLICATION: Japan

DOCUMENT TYPE: Journal  
ARTICLE TYPE: Original paper  
MEDIA TYPE: Printed Publication

FAERKKILAE M (1); PYYKKOE I (1); HEINONEN E (1)  
1990

...ABSTRACT: and selected samples of this population for electromyographic (N=80), autonomic nervous system function, controlled **breathing**, tilting bed and valsalva manoeuvre (N=88) tests, and a full clinical neurological examination. Mean...

...s phenomenon was 5%. The variations in heart rate (HRV) at rest and during deep **breathing** were observed. The traditional indexes of HRV (CV, CVS, MEAN) were computerized and calculated. There was a significant difference ( $p < 0.001$ ) between the HRV indexes during the deep **breathing** test in those with the shortest and the longest exposure to vibration. The values of...

---

7/3,K/39 (Item 1 from file: 144)  
DIALOG(R)File 144:Pascal  
(c) 2004 INIST/CNRS. All rts. reserv.

09514895 PASCAL No.: 91-0305300

**Carboplatin and etoposide in advanced lung cancer : a phase I study**

LIPPO K; NIKKANEN V; HEINONEN E

Univ. cent. hosp. Turku, dep. diseases, Turku 21 540, Finland

Journal: Cancer chemotherapy and pharmacology, 1990, 27 (3) 229-233

Language: English

LIPPO K; NIKKANEN V; HEINONEN E  
1990

...English Descriptors: agent; Platinum II Complexes; Chemotherapy; Treatment; Polychemotherapy; Phase I trial; Tumor; Bronchopulmonary; Human; Advanced stage; **Respiratory** disease; Toxicity; Malignant tumor

...French Descriptors: Complexe; Etoposide; Chimiotherapie; Traitement; Polychimiotherapie; Essai clinique phase I; Tumeur; Bronchopulmonaire; Homme; Stade avance; Appareil **respiratoire** pathologie; Toxicite; Tumeur maligne

...Spanish Descriptors: Platino II; Quimioterapia; Tratamiento; Poliquimioterapia; Ensayo clinico fase I; Tumor; Broncopulmonar; Hombre; Estadio avanzado; Aparato **respiratorio** patologia; Toxicidad; Tumor maligno

---

7/3,K/40 (Item 1 from file: 434)  
DIALOG(R)File 434:SciSearch(R) Cited Ref Sci  
(c) 1998 Inst for Sci Info. All rts. reserv.

04947315 Genuine Article#: QB959 No. References: 12

**Title: DIFFERENTIAL SENSITIVITY OF A-NERVE AND C-NERVE FIBERS TO LONG-ACTING AMIDE LOCAL- ANESTHETICS**

Author(s): ROSENBERG PH; HEINONEN E

Corporate Source: UNIV HELSINKI, DEPT ANAESTHESIOLOGY/SF-00290 HELSINKI

29//FINLAND//; UNIV HELSINKI, DEPT PHYSIOLOGY/SF-00170 HELSINKI 17//FINLAND//

Journal: BRITISH JOURNAL OF ANAESTHESIA, 1983, V55, N2, P163-167

Language: ENGLISH Document Type: ARTICLE

**Title: DIFFERENTIAL SENSITIVITY OF A-NERVE AND C-NERVE FIBERS TO  
LONG-ACTING AMIDE LOCAL- ANESTHETICS**

**Author(s): ROSENBERG PH; HEINONEN E**

**, 1983**

**...Research Fronts: AND BRAIN SURGERY)**

**83-4821 001 (PHARMACOLOGY AND COMPARATIVE CENTRAL-NERVOUS-SYSTEM  
TOXICITY OF LOCAL- ANESTHETICS LIDOCAINE, ETIDOCAINE, BUPIVACAINE AND  
TETRACAINE)**

**83-6197 002 (METHODS OF DIFFERENTIAL NERVE FIBER BLOCK INCLUDING  
LIDOCAINE, ACUPUNCTURE AND AMIDE ANESTHETICS )**

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Set	Items	Description
S1	2	AU=(HEINONEN E? OR HEINONEN, E?)
S2	0	ERKKI(2N)HEINONEN
S3	569174	BREATH? OR RESPIRAT? OR VENTILAT? OR ANESTHE? OR ANAESTHE? OR INSUFFLAT?
S4	0	IC=(A61B? OR A61M? OR G01F?)
S5	2	S1:S2 AND S3:S4
S6	2	RD (unique items)

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File 130:PHIND(Daily & Current) 2004/Dec 16  
(c) 2004 Informa UK Ltd

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(c) 2004 The Gale Group

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(c) 2004 Reed Business Information Ltd.

File 370:Science 1996-1999/Jul W3  
(c) 1999 AAAS

File 441:ESPICOM Pharm&Med DEVICE NEWS 2004/Dec W2  
(c) 2004 ESPICOM Bus.Intell.

File 444:New England Journal of Med. 1985-2004/Dec W2  
(c) 2004 Mass. Med. Soc.

File 621:Gale Group New Prod.Annou.(R) 1985-2004/Dec 16  
(c) 2004 The Gale Group

?

6/3,K/1 (Item 1 from file: 149)  
DIALOG(R)File 149:TGG Health&Wellness DB(SM)  
(c) 2004 The Gale Group. All rts. reserv.

02346326 SUPPLIER NUMBER: 114819676 (USE FORMAT 7 OR 9 FOR FULL TEXT  
)

Side effects of endotracheal suction in pressure- and volume-controlled  
ventilation \*. (laboratory and animal investigations)

Almgren, Birgitta; Wickerts, Carl-Johan; Heinonen, Erkki ; Hogman,  
Marieann

Chest, 125, 3, 1077(4)

March,

2004

PUBLICATION FORMAT: Magazine/Journal; Refereed ISSN: 0012-3692

LANGUAGE: English RECORD TYPE: Fulltext TARGET AUDIENCE: Professional

WORD COUNT: 3215 LINE COUNT: 00331

Side effects of endotracheal suction in pressure- and volume-controlled  
ventilation \*. (laboratory and animal investigations)

... Heinonen, Erkki

TEXT:

Study objectives: To investigate the effects of endotracheal suction  
in volume-controlled **ventilation** (VCV) and pressure-controlled  
**ventilation** (PCV) with an open suction system (OSS) or a dosed suction  
system (CSS).

Design: Randomized comparison.

Setting: Animal research laboratory.

Patients: Twelve healthy **anesthetized** pigs.

Interventions: The effects of endotracheal suction during VCV and PCV  
with tidal volume (VT...

...more severe and persistent in PCV than in VCV.

Key words: gas exchange; lung; mechanical **ventilation** ; pigs;  
suction; trachea; venous admixture

Abbreviations: ANOVA = analysis of variance; Crs = compliance; CSS =  
closed suction...

...MPAP = mean pulmonary arterial pressure; OSS = open suction system; Paw  
= airway pressure; PCV = pressure-controlled **ventilation** ; PEEP = positive  
end-expiratory pressure; Pplat = plateau pressure; VCV = volume-controlled  
**ventilation** ; VT = tidal volume

\*\*\*\*\*

Patients dependent on mechanical **ventilation** often need to have  
mucus suctioned from their airways. Because endotracheal suction may create  
negative...

...which can lead to desaturation. To minimize the risk of complications  
during endotracheal suctioning, various **ventilator** settings have been  
proposed to prevent desaturation and loss of lung volume. (1-3)

Different...

...shown to prevent arterial and systemic venous oxygen desaturation and  
lung collapse during volume-controlled **ventilation** (VCV). (8)

Negative effects after endotracheal suction during VCV have been  
described, but we have found no study that compares the effects of  
suctioning during VCV and pressure-controlled **ventilation** (PCV). Our  
hypothesis is that endotracheal suction might have different side effects  
depending on **ventilator** mode and suction method; therefore, we compared  
the effect of endotracheal suction on hemodynamics and...

...PCV and VCV with different suction systems and catheter sizes.

#### MATERIALS AND METHODS

Twelve healthy **anesthetized** pigs of mixed breed (Hampshire, Yorkshire, and Swedish native breed) with a body weight ranging...

...was performed in accordance with the recommendations of the Swedish National Board for Laboratory Animals.

#### Anesthesia

Before transport to the laboratory, the pigs were premedicated with 40 mg of azaperon administered by IM injection. **Anesthesia** was induced with 0.5 mg of atropine and a mixture of 100 mg of...

...mm inner diameter. A bolus injection of 0.2 mg of fentanyl was administered IV. **Anesthesia** was maintained by infusion of 5 mL/kg/h of a solution containing 4 g...

...mg of pancuron in 1,000 mL of Rehydrex with glucose.

All pigs received mechanical **ventilation** (Evita 4; Drager Medical; Lubeck, Germany) in either volume-controlled (intermittent positive pressure **ventilation**) or a pressure-controlled (bilevel pressure **ventilation**) modes. **Ventilator** settings were fraction of inspired oxygen of 0.3 and PEEP of 3 cm (H...

...mL/kg or inspiration pressure level was set to achieve VT of 14 mL/kg. **Respiratory** rate was adjusted to achieve a stable end-tidal  $C(O_{2sub.2})$  of 5...

...the Y-piece for dynamic gas monitoring. Fraction of inspired oxygen, fraction of expired oxygen, **respiratory**, rate, VT, end-tidal carbon dioxide, compliance (Crs), Paw, and Pplat were registered. All measurements ...

...to the method described by Berggren. (10)

#### Protocols

The effects of endotracheal suction during two **ventilation** modes, VCV and PCV, were compared. Both **ventilation** modes were applied in random order in all pigs. An OSS 14 catheter was used...

...VCV was used. One possible explanation is that in VCV, where the volume of each **breath** is the same, there is a small recruitment with each successive **breath**. However, in VCV, the changes in both Crs and Pplat remained 30 min after suction...

...might lead to overdistension of those parts of the lung that remained open. During artificial **ventilation**, it is important to prevent lung collapse and thus minimize the risk of **ventilator**-induced lung injury. Daily suction procedures--sometimes even hourly suction procedures--are required to clear...

...and gas exchange impairment that remains long after completed suction. When CSS is used, the **ventilator** can deliver **breaths** even though the suction catheter has been inserted into the endotracheal tube, provided that the catheter is narrow enough to allow the **ventilator** to continue **ventilation** and maintain PEEP. Maintained PEEP could explain why less desaturation was found in patients with...

...sedated and paralyzed. (8) The present study was done in healthy pigs that were deeply **anesthetized** to keep the experimental model unaffected by stress; under these conditions, no changes in HR...

...H.sub.2)O). The hemodynamic changes might be more prominent if other conditions and **ventilator** settings were used.

In conclusion, our study provides further evidence that endotracheal suction can cause...

...05).

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